POWER

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THE WAR'S BENEDICTION

FATE sits on the rim of Heaven writing a New Genesis. Here a line with the blood of heroic dead, there a line with the tears of sorrowing women.

The words are the nebula of Human Aspirations. And the composition assumes form by force of the gravity that is Brotherhood.

We shall read it by the light of a sun that is the New Purpose, for the past is Ptolemaic and the future Copernican.

In this Apocalypse there are no chosen people. The rich, the poor, the toiler and the master alike are led from the bondage of the Past's insecurity.

The pathway is bloody and appalling. Yet from it rises a mighty hallelujah of Deliverance.

FEAR NOT,
ye Kings of Capital!
STRIKE NOT,
ye Toiling Millions!
BE PATIENT,
ye Engineers!

YE are the New Trinity that is come with one mind, one heart, one purpose—to conduct as one unit this machine called Civilization; not for wealth or vain aggrandizement, but to make the world a better place to live in. And in the living and the service find the true reward.

By CHARLES H. BROMLEY

Operation and Maintenance of Elevators—Geared Traction Machines

By R. H. WHITEHEAD

The construction and operation of the geared type of traction-elevator machines are discussed. Three types are considered: The overhead machine using a secondary-idler sheave; basement type using a secondary idler sheave; and overhead type without a secondary idler sheave, but employing a traction driving sheave having V-shaped grooves.

WITH the winding-drum type of elevator machine, the limitation of car rise is determined by the drum dimensions and these fix the car travel to about 150 ft. To meet the elevator problems evolving as the result of modern skyscraper buildings, another

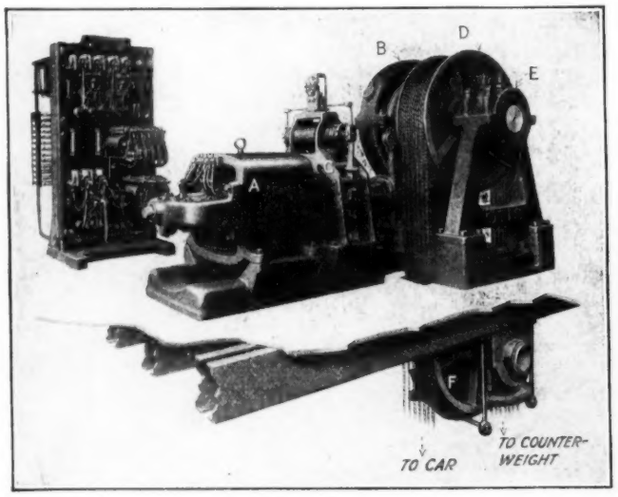


FIG 1. GEARED TRACTION ELEVATOR MACHINE

type of elevator machine had to be developed. This is known as the traction type and derives its name from the fact that instead of the ropes being wound upon a drum to give the car motion, as in the winding-drum type, motion is obtained by means of the traction existing between the driving sheave and the hoisting ropes.

There are two general types of traction machines—geared, Fig. 1, and gearless, Fig. 2. The geared type is used for low and medium rises and car speeds up to about 350 ft. per min., while the gearless type is used for high lifts and car speeds up to 600 and 700 ft. per min. Two of the gearless-traction elevator machines in the Woolworth Building, New York City, have an actual car travel of 680 ft. Geared-traction machines are also frequently used for low lifts in place of the drum type of machine.

It will be seen from Fig. 1 that the geared type of traction machines is similar in appearance to the winding-drum type, having a motor *A*, worm and worm gear in the case *B*, and a brake wheel and brake *C* mounted between the gear and motor. However, instead of the spirally grooved drum used on the winding-drum machine, a multi-grooved driving sheave *D* is keyed to what is the drumshaft in the drum-type machine. The grooving on a drum-type machine forms a helix starting from one end of the drum and running to the other end or ending at the center, as the case may be. On the traction machine the grooves on the sheaves form closed circles about the sheave, the number of grooves depending upon the number of ropes, generally two grooves for each rope.

In passing, attention might be called to the arrangement of the gearless type of machine, Fig. 2. It will be seen that, as the name would indicate, no gears are used, the driving sheave being mounted directly on the motor shaft, along with the brake wheel. This means that a very slow-speed motor must be used. This type of machine will be given further consideration in another article.

The geared-type traction-elevator machine, as shown in Fig. 1, is the equivalent for load and speed to the

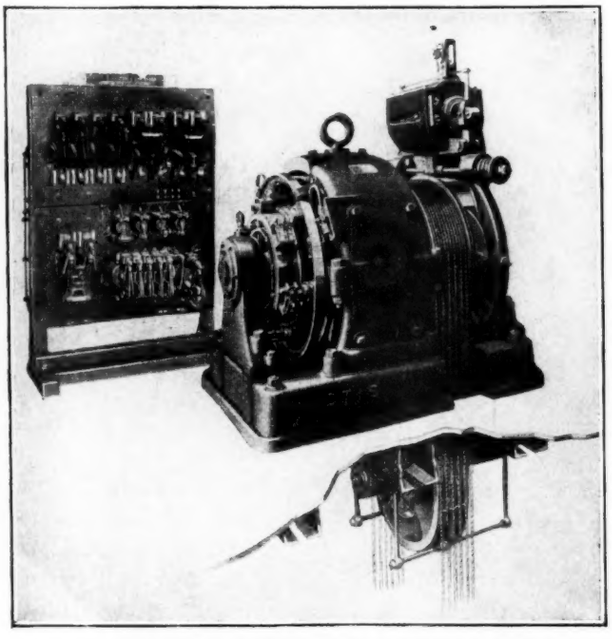
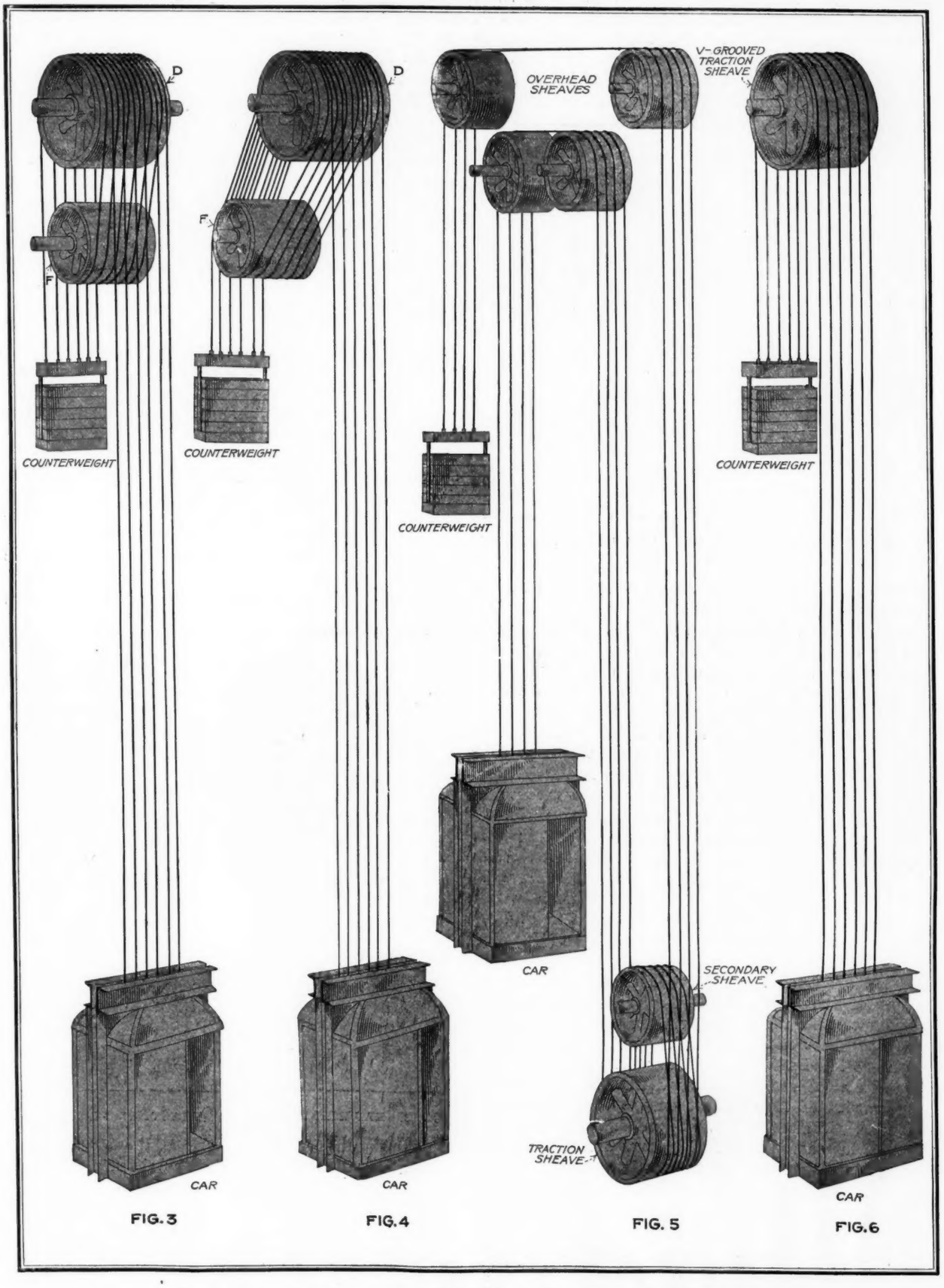


FIG. 2. GEARLESS TRACTION ELEVATOR MACHINE

drum-type machine, using the same motor, brake and gears, the main difference being, as previously mentioned, that the geared-traction machine uses a driving sheave instead of a spirally grooved drum of the same diameter. The general type of traction machine employs the use of a grooved secondary idler sheave *F*, as shown in Fig. 1, to obtain sufficient tractive effort.

In the traction type of installation the ropes are continued from the car to the counterweights, just as the car-counterweight ropes are in the drum type, but in the former only one set of counterweights is used. The roping for an overhead machine of the general type is shown in Figs. 3 and 4. The ropes pass



FIGS. 3 TO 6. DIFFERENT ARRANGEMENTS OF ROPING UP TRACTION ELEVATOR

Figs. 3 and 4—Cable arrangement when machine is located overhead. Fig. 5—Roping scheme when machine is located in the basement. Fig. 6—Roping up when a V-grooved traction sheave is used.

from the car over separate grooves in the driving sheave *D* down and around under the idler sheave *F*, up over the traction sheave *D* again and then down to the counterweights. It is seen from this that the car is connected to one end of the cables and the counterweights to the other. This scheme of roping up the car and counterweights gives sufficient friction between the sheave and rope to get the proper tractive effort for all conditions of load.

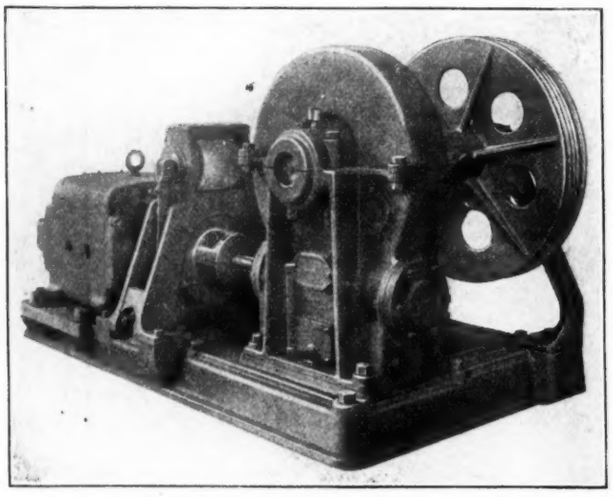


FIG. 7. V-GROOVED DRIVING-SHEAVE TYPE TRACTION ELEVATOR MACHINE

In Figs. 3 and 4 there are six cables. To accommodate them on the sheaves there must be twelve grooves in the sheaves. These six cables as they come from the car fall into every other groove on the driving sheave; that is, starting from one end of the sheave, say in grooves 1, 3, 5, 7, 9 and 11, they pass down around in grooves of the same number in the secondary sheave and up into the remaining grooves in the driving sheave. This would bring rope No. 1 into grooves 1 and 2 of the driving sheave and in groove No. 1 in the secondary sheave, leaving groove No. 2 in the secondary sheave unoccupied when this sheave is located directly under the driving sheave, as in Fig. 3.

Where the driving sheave spans the distance between the center of the car and counterweights, as in Fig. 3, the use of the secondary sheave permits of having slightly more than two complete half-turns of contact with each rope on the driving sheave. This is on account of the idler sheave being somewhat smaller in diameter than the driving sheave. When the driving sheave does not span the car and counterweight centers, as in Fig. 4, the secondary sheave is also used as a deflector sheave, but doing this results in losing a small amount of rope contact on the driving sheave, consequently some traction. From Fig. 4 it will be seen that the same number of grooves are occupied on the secondary sheave as on the traction sheave.

Experiments made with well-lubricated ropes and also with dry ropes on traction sheaves of this type show that with an installation properly designed there is no slippage of rope on the driving sheave under any condition of loading excepting a slight slippage which sometimes occurs when the car is suddenly stopped or started.

In some cases a V-shaped groove is used instead of the regular semicircular rope-shaped groove on the driving sheave. This groove is shaped like the letter V as implied by the name, and the traction is obtained on the driving sheave without the use of a secondary sheave, from the wedging action between the grooving and the ropes. A geared traction machine of this type is shown in Fig. 7. This is similar to the winding-drum type in every detail, except in place of the drum a sheave having a number of V-shaped grooves in its periphery is used, as shown in the figure. The ropes run directly from the car over the driving sheave down to the counterweights, as shown in Fig. 6.

The V-grooved machine costs less to build than the semicircular-grooved type, Figs. 1 and 2, since not only is the secondary sheave omitted, but in addition it is possible to use lighter construction on the driving sheave and shaft as the downward strain is only one-half as much. The driving sheave is only one-half as wide, as the ropes are not doubled back as in the case of the type using a secondary sheave.

The V-grooved type, however, gradually loses its tractive effort due to the wearing of the groove by the rope. This wear tends to make the grooving semicircular and when this occurs, the ropes will start to slip, as they no longer wedge in the groove. With the secondary-sheave type the tractive effort does not decrease with increased usage, since the grooves remain the same shape and the rope contact therein remains the same.

The traction type of elevator machine should always be installed overhead if possible, as shown in Figs. 1 and 2. The basement type of geared-traction machine is shown in Fig. 8. The roping of such a machine is given in Fig. 5. A comparison of Fig. 5 with Figs. 3 and 4, for an overhead installation, shows that for the same rise about twice the amount of rope is required for the basement-type installation, and in addition the rope must be deflected over several extra sheaves. This results in shorter rope life and higher

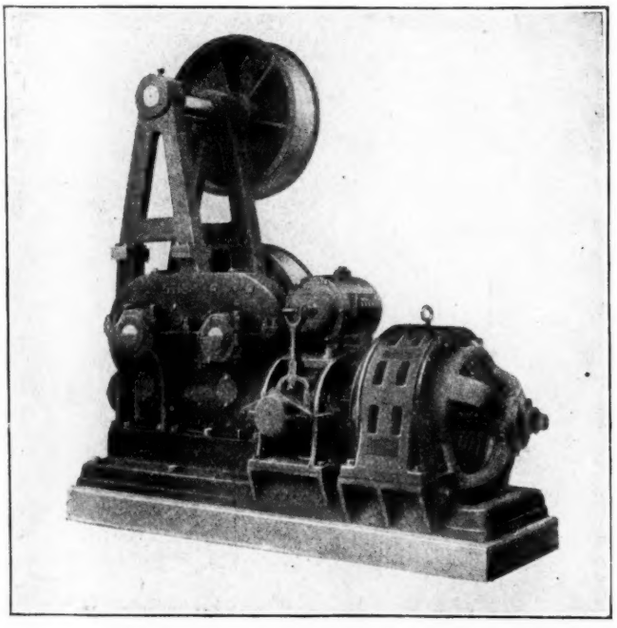


FIG. 8. BASEMENT TYPE OF TRACTION ELEVATOR MACHINE

power consumption, and the first cost of the installation is greater, not only on this account but also for the extra overhead sheave.

In Figs. 1 to 4 it will be noticed that there are six independent ropes leading up from the car to the driving sheave, then to the secondary sheave and back to the driving sheave and to the counterweights. These ropes are usually steel and are $\frac{5}{8}$ in. to $\frac{3}{4}$ in. in diameter. With this type of installation it is important that the strain be kept equal in all ropes by adjusting them with the take-up arrangement provided on the car crosshead and counterweight frame. When any one of the ropes takes less than its share of the load, this particular rope loses its traction and a loss of traction results as a whole.

Each rope is provided with a swivel hitch of the ball-socket type. This prevents any twisting strain on the ropes and relieves them of the bending strain at the hitch. With the general type of traction machine using a secondary sheave, the minimum traction under any condition is such that the rope will not slip until the load on the heavy side is about twice that on the light side. which means that with the machine 40 per cent. over-counterweighted the load on the car must equal about 200 per cent. rated capacity before there is any danger of the cables slipping on the driving sheave.

Slippage a Point in Favor of This Type

The fact that slippage will occur is a very strong point in favor of this type of installation, because when the car bottoms in the pit the traction is lost and the counterweights cannot travel farther; even though the driving sheave continues to turn, it cannot exert sufficient tractive effort on the ropes to haul the counterweights into the overhead work. This also applies when the counterweights bottom in the pit; the driving sheave cannot pull the car up into the overhead work.

A machine automatic like that used on the drum machine for stopping the car at the top and bottom landing cannot be used on the geared-traction machine, because of a possible slippage of the cables under the conditions enumerated. Consequently, additional switches instead are provided, similar to the hoistway-limit switches, at the top and bottom of the hoistway. These switches are operated by the cam on the car that operates the hoistway-limit switches and fulfills the same function as the automatic located on the drum shaft of the winding-drum type of machine.

The first limit brings the car down to slow speed, in the case of a direct-current motor, by opening the circuit to the magnet coil, which weakens the shunt field, thereby increasing the field strength to normal value, and with an alternating-current motor slow-down is accomplished by disconnecting the high-speed winding of the motor from the line and in its place connecting the slow-speed winding. The next limit switch generally opens the direction switch for the direction of car travel, and farther travel of the car will open the hoistway-limit switch, which opens the main potential switch. High-speed installations, where the control is more complicated, will be discussed in a future article.

The limit switches, wherever conditions permit, should let the reversing switches open automatically when the car is level with the top and bottom landings, and a normal automatic stop with any load in the car should not operate the hoistway limits.

The rope length should be adjusted so that the counterweight does not bottom until after the top hoistway-limit switch opens. Conditions of overhead car and counterweight clearance sometimes necessitate deviation from the foregoing and make it necessary for the reversing switches to open automatically before the terminal landings are reached, the inertia of the machinery being depended upon to bring the car to the landing. This is objectionable inasmuch as the operator tends to stop the machine on the limits instead of the automatics, and if he uses the car switch and stops the car before the floor level is reached, he must go back and make another trial.

Geared-traction cars are sometimes provided with appliances used ordinarily on the gearless type; that is, stopping switches mounted on the car, operated by a cam in the hoistway, instead of the limit switches previously described; and oil buffers instead of spring buffers for both car and counterweight are used.

Ordinarily, however, the geared-traction installation is a duplicate of the winding-drum type except for the difference as shown in this article, and with this type of machine it is possible with either alternating or direct current to meet the elevator problems in high-rise installations for moderate speeds.

As pointed out in the foregoing, the geared-traction machine is generally used only for car speeds up to 350 ft. per min., and for speeds of 400 to 700 ft. per min. the gearless type is used.

As in the winding-drum type of machine, the driving-sheave shaft is equipped with marine collared bearings in the outboard stand and in the wormwheel case to resist the side thrust of the wormwheel. The geared-traction machine is also built either on the single-screw type, Fig. 1, or the double-screw type, Fig. 8. Thrust bearings are provided on the wormshaft of the single-screw machine to take the thrust between the worm and gear. In the double-screw type no thrust bearings for the wormshaft are required as a right and a left worm on the same shaft engages a right and a left wormwheel, which in turn mesh as spiral gears, thus forming a three-point drive.

Pollution of Streams

"The court knows judicially that modern science has demonstrated that the use of water in power plants and for other purposes where human beings must of necessity be in attendance about it seriously endangers its purity, rendering it unfit for human consumption," declared the Washington Supreme Court in the recent case of City of Raymond vs. Willapa Power Co., 167 Pacific Reporter, 914.

Accordingly, the court rendered the decision that plaintiff city, having acquired the right to use the waters of a stream in operating a water-supply plant, was entitled to enjoin defendant from interfering with this right by impounding the waters of the stream above the city's intake for use in developing electricity, although the waters were returned to the stream by defendant company.

Pitch as a Fuel for Power Generation

By JOHN B. C. KERSHAW

A summary of the most recent patents and experiments relating to the use of coal-tar pitch as a fuel for steam boilers and for internal-combustion engines.

THE great increase in the number and capacity of the byproduct coke ovens in the United States and in the number of works for the distillation of coal tar (in order to obtain "toluol," the chief raw material for explosive manufacture) has led to an overproduction of pitch and to accumulations of this material in all tar-distillation works. This overproduction will continue when peace is declared and the demand for explosives falls to its normal level, for the products of tar distillation will then be absorbed in the organic color industry.

In the past, coal-tar pitch has been employed chiefly as a roofing, waterproofing and paving material, its comparatively low melting point and high percentage of volatile hydrocarbons having prevented its use on any considerable scale as a fuel, with the one exception of its application as a binding agent in the manufacture of anthracite briquets.

The increase in the output of pitch in the United States during the war and the fact that over two million tons of this solid hydrocarbon is now produced annually in the tar-distillation works of the country have led to a revival of interest in the possibilities of pitch as a fuel, either for burning in the solid state under steam boilers or for use in the liquid state in internal-combustion engines.

Chemical Properties of Pitch

Before dealing with the practical methods of utilizing pitch as a fuel, it will be advisable to review briefly its chemical and physical properties, since the question of its successful application as a source of motive power hinges largely upon a correct appreciation of the difficulties attending its proper combustion, either in the solid or the liquid state.

When coal tar is heated in the usual type of 20-ton still in order to separate and recover the more valuable constituents, with boiling-points below 270 deg. C., there remains in the still a residue known under the trade name of pitch.

Chemically, pitch is a mixture of hydrocarbons containing oxygen, nitrogen and sulphur. The constitution varies with the source of the tar and also with the temperature to which the distillation has been pushed in order to recover the oils of lower boiling point. One ton of an average tar under ordinary conditions of distillation will yield the following products: Benzol, ¼ gal.; toluol, ⅜ gal.; solvent naphtha, 1½ gal.; heavy naphtha, 1 gal.; carbolic acid (crude), 2-3 gal.; crude cresylic acid, 2 gal.; creosote oils, 20 gal.; anthracene oils, 34 gal.; naphthalene, 112 lb.; pitch, 10 cwt.

The light oils distill at a temperature below 170 deg. C., the carbolic or middle oils at temperatures lying between 170 and 230 deg. C., and the heavy or creosote oils from 230 to 270 deg. C. The anthracene oils come over only at higher temperatures (from 270 to 400 deg. C.), and the distillation is not always carried so far as to remove these oils entirely from the pitch. A large portion of the pitch, 10 to 50 per cent., consists of finely divided carbon, but from 50 to 90 per cent. consists of solid unsaturated hydrocarbons of the aromatic type, which give the pitch its distinctive properties. According to Martin, the elementary analyses of hard and soft pitch yield the following: Hard pitch, 93.2 per cent. carbon, 4.4 per cent. hydrogen; soft pitch, 91.80 per cent. carbon, 4.60 per cent. hydrogen.

The calorific value of pitch is extremely high, a sample tested by the writer in the bomb type of calorimeter having shown 15,928 B.t.u., or a higher value than that of the best Welsh steam coal. This high calorific value is, however, counterbalanced by the production of a high percentage of volatile hydrocarbons when it is heated, the following being an approximate analysis of a north-country pitch: Moisture, 0.05 per cent.; ash, 0.60 per cent.; volatile matter, 66.85 per cent.; coke, 33.15 per cent.; fixed carbon, 32.55 per cent.

Its Physical Properties

As regards the physical properties of pitch, the specific gravity varies from 1.20 to 1.35, the hard pitch produced when the distillation of the tar has been carried to a high temperature having the higher specific gravity.

The melting point likewise varies within wide limits, but it must be noted that the term melting point when applied to pitch is an arbitrary one, since the material when heated gradually softens and passes by almost imperceptible stages into the liquid state. The limits of melting point noted are 37½ deg. C. in water and 174 deg. C. in air, but a pitch melting at 37½ deg. C. (100 deg. F.) would hardly deserve to be classed as a pitch, since this low melting point would signify that the distillation had only been carried far enough to drive off the water, lighter oils and some portions of the carbolic oils.

Pitch, as shown by the analyses previously given, is composed chiefly of free carbon and of hydrocarbons which become volatile on heating above 400 deg. C. It is therefore combustible and under proper conditions can be burned to CO_2 and H_2O vapor, with the production of heat equivalent to 15,900 B.t.u. per lb. of pitch consumed. The very high percentage of volatile hydrocarbons which are evolved when it is heated above its melting point, however, renders it difficult to burn pitch without the production of smoke, for even if the problem of keeping the air supply adequate for the proper combustion of these hydrocarbon gases be solved, there is still the difficulty of securing a proper admixture of the air and of the evolved combustible gases. These gases also are liberated at a lower temperature than in the case of bituminous fuel, and this signifies that they require further heating before they reach the ignition point, otherwise they may escape from the furnace unconsumed, without yielding any of their heat value. This analysis of the difficulties of burning pitch as a

solid fuel under steam boilers shows that special arrangements are necessary and that it is useless to simply shovel the lumps of pitch mixed with the coal into the furnace and expect good results from the mixture.

In fact, when such attempts are made to burn pitch in the ordinary furnace under Lancashire steam boilers, the pitch softens and melts, and closes the air spaces in the grates before the liberation or the ignition of the gases has occurred. Dense volumes of black smoke are therefore produced by this cutting down of the air supply at the time when a large excess of air is required for efficient combustion, and the fire side of the tubes of the boiler and economizers becomes covered with a thick, oily deposit of soot, which enormously reduces the transmission of heat to the water. The hydrocarbons contained in coal pass from the solid to the gaseous state on the application of heat without assuming this intermediate or liquid stage, and for that reason coal is much more easily burned than pitch.

The conditions required for burning solid pitch are therefore three in number: An adequate supply of air, above or through the grate; an adequate admixture of this air and the evolved gases, and means for raising this large volume of air and hydrocarbon gases quickly to the ignition point of the latter.

Burning Pitch Under Lancashire Boilers

The managers of certain gas works are reported to have solved the problem of burning pitch under Lancashire steam boilers, with the aid of forced draft and a special type of channeled solid fire-bar, known as a pitch-bar.

Some of the ordinary fire-bars of the furnace are removed, and the pitch-bar substituted, the number and distance apart of the latter depending upon the character and volatile matter contained in the fuel that is being consumed on the other portions of the furnace grate. The pitch, broken to a convenient lump size, is fed onto the front end of these special pitch-bars, preferably by some type of mechanical feed, which will maintain a regular supply without opening the furnace door. The heat of the surrounding fire causes the pitch first to melt and to flow down the channel of the bar and then to volatilize. The rate of such volatilization is said to be controlled by the form of the bars, and the forced draft supplies the surplus-heated air which is required to secure the combustion of the hydrocarbon gases produced from the molten pitch. The partly coked residue which remains after the more volatile constituents have been driven off and burnt, is then pushed to the rear portion of the grate, where its combustion as ordinary coke offers no special difficulties. Details of this method of burning have been published.[1]

Pitch is also being burned in a tar-distillation works in the North, in conjunction with breeze and coal under Lancashire steam boilers, in the proportions of 75 per cent. breeze, 18 per cent. pitch and 7 per cent. coal, without any trouble from smoke. The boilers in this case are hand-fired and work under natural draft. It will be observed that the proportion of pitch is only about one-sixth of the total weight of fuel used, and as the breeze evolves only a comparatively small amount of hydrocarbon gases, the final volume of combustible gas to be consumed is not large.

[1] "Chemical Trade Journal," Nov. 4, 1916.

At one time a mixture consisting of 45 per cent. crushed pitch and 55 per cent. breeze was employed. The steam-raising value of this mixture was good, but it produced smoke, and in time resulted in an oily deposit of soot on the economizer tubes. This deposit could not be removed by the scrapers and eventually had to be burnt off. Probably if forced-draft apparatus had been installed with a preheated air supply, this half-and-half mixture of pitch and breeze could have been burned without any trouble, since a deficient air supply was undoubtedly the cause of the sooty deposit.

The possibilities of using pitch as a liquid fuel under steam boilers do not appear to have been yet investigated upon a practical scale, although this method of employing pitch would probably prove the most efficient and the least costly to work when once the necessary apparatus had been installed. The distillation of the tar in this case would be stopped when the light and middle oils had been distilled (that is, at 200 deg. C.) and the soft pitch which remained in the still would be utilized in the semi-liquid state in a modified form of the usual atomizing injector, using superheated steam or hot air under pressure, as motive power. The preheating of the air supply and the thorough admixture of the minute globules of liquid pitch and the air could be most effectively carried out by this system of combustion, and since coal tar has already been utilized successfully in this way, the atomizing of a material that is only slightly more viscous at ordinary temperatures would not offer insuperable difficulties.

In this connection the patent of Arnold Philips, an Admiralty chemist at Portsmouth, England, for reducing the viscosity of thick oils, may be referred to. In this patent (No. 14,778 of 1913) the addition of 8 per cent. of naphthalene is specified for rendering certain thick oils more suitable for fuel purposes. If the naphthalene be left in the pitch, it is reasonable to suppose that it will also have the same effect in rendering the latter more suitable for atomizing purposes. Should difficulties from cooling and partial solidification occur in the spraying nozzle, these no doubt will be overcome by inclosing the latter in a heat-insulating jacket, through which the preheated air or superheated steam would be passed before entering the atomizing nozzle.

Recent Patents Dealing With the Subject

As regards recent patents dealing with this subject English patent No. 101,444 of 1916, granted to G. H. H Bölling, of Christiania, describes a method of melting the pitch by means of the heat of a steam coil and introducing it through similarly heated pipes into the furnace, where it is atomized by a jet of steam or air. The steam jackets, pipes and valves are so arranged that any incrustation may be removed. German patent No. 290,708 of 1914, granted to Robert and Trinyi, relates to the similar use of powdered pitch as a fuel, the pitch in this case being blown into the furnace in the form of dust. Finally, the English patent of G. Heyl (No. 110,023 of 1916) may be referred to, according to which liquid fuels suitable for firing furnaces and for use in high-compression oil engines, can be manufactured with the aid of pitch, by treating mineral oils and heavy creosote oils with solid caustic soda, to neutralize the acids present and to remove sul-

phur compounds. The oil is cooled to eliminate the naphthalene (a mistaken proceeding in the light of Philips' discovery) and is then heated with pitch. It is stated that up to 50 per cent. of the latter by weight can be dissolved by this method of procedure.

One method of rendering pitch sufficiently fluid to be used in internal-combustion engines is described in the foregoing, and it is highly significant that the Controller of the Mineral Oil Production Department of the Ministry of Munitions is now arranging for trials of mixtures of pitch and creosote, in order to test their suitability for this particular purpose. The writer has been informed, however, by an electrical engineer who has had some experience in the use of such mixtures for Diesel engines, that used in the ordinary way they are not very satisfactory, owing to starting difficulties and to incomplete combustion in the engine cylinder. When burned, however, with the aid of a pilot ignition apparatus, they give quite good results. With this apparatus 5 per cent. of petroleum oil is injected into the cylinder just before the creosote and pitch mixture enters, and this pilot charge of a more easily ignited oil enables the temperature to be kept sufficiently high to obtain proper combustion of the composite heavier oil.

The chief difficulty in using heavy oils in gas engines is of course to prevent imperfect combustion, and the consequent choking of valves, etc., with carbon. Should this occur, the use of a mixture of wood alcohol and ammonia has been used for removing these deposits without the application of heat, but the writer is unable to state whether this mixture has proved satisfactory in practice. Burning off, the usual plan, is of course efficacious, but it is troublesome, and a liquid agent which would act in the cold would have much in its favor.

Progress Is Being Made

This summary of the most recent patents and experiences relating to the use of coal-tar pitch as a fuel for steam boilers and for internal-combustion engines, shows that some progress is being made. The methods of rendering pitch sufficiently fluid to be used in atomizers are in the opinion of the writer the more hopeful, and he is less confident that pitch can be used economically in the solid and pulverized condition for firing steam boilers.

The fact that pitch softens at a comparatively low temperature means that the heat generated by friction in the pulverizing apparatus will have to be dissipated by artificial cooling, to prevent the grinding surfaces becoming clogged with half-melted pitch, and this artificial cooling must add considerably to the costs of the grinding operation. In the methods of rendering pitch more fluid, the heat added to the material is of direct service later in accelerating and improving the combustion in the boiler furnace or engine cylinder; consequently, the heat is not wasted, but is preserved and made effective at a later stage of the combustion process.

It would seem, however, a waste of time and heat energy to first separate the constituents of coal tar by distillation into four or five separate portions and then to recombine some of these portions in order to obtain a mixture suitable for use as a liquid fuel. The writer considers that the future line of development will be to carry the distillation only far enough to win the lighter oils and the phenols from the raw tar, and that the residue from the stills, containing the heavy creosote oils, the naphthalene and the pitch, will be sold and utilized as a liquid fuel. The anthracene oils, which are the last constituents of the raw tar to distill over (270 — 400 deg. C.), would in this case be left in the pitch, and only when the demand and price offered for the anthracene made its extraction profitable would the complete distillation of the raw tar and separation of all the possible classes of its constituents be carried out.

The Use of Metallic Gaskets

By W. B. Haynes

When a gasket of any description is offered to you with the assurance that it will stand air, oil, gas, water, steam of any temperature, expansion and contraction, electrolysis, etc., you smile sweetly, and while you try to be polite and say "very interesting," it occurs to you that someone has a lot to learn about gaskets. Let me set down my belief regarding metallic gaskets, their uses and limitations, reserving the right to change my mind on these points if I am wrong.

The ordinary corrugated copper gaskets are approximately $\frac{1}{64}$ in. thick and are generally used as a ring inside the bolt circle, and two in a joint, because when only one is used the flanges are apt to spring enough under the strain of the bolts to touch, iron to iron, outside the bolts, permitting a leak. In other words, one thin copper gasket is not enough for the ordinary commercial flanges to "get a bite on." When two gaskets are used, they should be meshed the same way of the corrugation. Metal gaskets should be coated with pipe cement, graphite and oil, or lead and oil, and bolted up before the coating has dried, so that each corrugation flattening under the pressure forces a ring of this filler concentrically around the flange, and the copper gasket practically acts as a binder. There are, however, exceptions to this rule of two gaskets, especially on low-pressure work. Copper gaskets should be annealed soft and pliable, as the final process, because in the process of corrugating it becomes hard, stiff and springy. This is because in corrugating, the fibers of the metal are strained and thrown out of harmony and mesh. Annealing brings these fibers back into harmony and restores the strength of the metal, therefore always mark orders for soft gaskets "to be annealed after making."

A steam-fitting contractor doing bad work, if he only wants to "get an acceptance of the job, get his money and get out," looks with disfavor on gaskets of the thin variety because he has to do a good job to get an acceptance.

The ideal gasket is one that covers the pipe ends as well as the flange, if the pipes are faced off flush with the flange, because such a gasket will save thread leaks. If, however, the pipe does not come out flush with the flange, this cannot be accomplished with any gasket. The following trite saying of a purchasing agent is worth repeating: "We have joints in our power plant that cannot be opened for replacing gaskets for a less cost than ten dollars. We cannot, therefore, afford to put in a poor gasket as it is putting on a mortgage that will be foreclosed with a blowout."

Conditions in the Power Industry

By L. W. SCHMIDT

A digest of the reports of United States consuls on the power situation in various parts of the world and the influence of the war on this important industry. Also see "Power," June 4, 1918.

BY ENFORCING increased economic activity over practically the whole world, the war has widened the field of electric power. Lack of man power has probably been the principal factor in this development, but there is plenty of evidence that electric power will be used after the war in many places where before it was only in the experimental stage. The report comes from England (C. R. 78)[1] that extensive use may be made in agriculture of the so-called electrification of crops, which consists in exposing growing crops to electric light. This treatment adds largely to the productive power of the plants according to extensive experiments made before the war. There has been formed in England the Electric Discharge Co., which enterprise intends to treat not only growing crops, but also the seeds. Plants for the treatment of seeds have been erected at several places in England, and it is said that the increase in the yield from seeds so treated is between 25 and 80 per cent.

Wind Motors for Cheap Power

If the method generally proves successful, it will open a new field for the power industry. Cheap power, of course, will be needed for the purpose, and it has been suggested that electric power generated by wind motors be used for the purpose of crop electrification. The argument in this case is that power generated in this way costs practically nothing beyond the expense of the installation and its upkeep, and that any power that can be obtained by wind comes handy for crop treatment, since there is no need for maintaining a regular supply of power.

England feels more and more the effect of the high cost of living on power production. Following the example of other cities, Birmingham has increased the cost of electric power to consumers. The rate of increase affects both light and power and amounts to between 10 and 15 per cent. To prevent electrical consumers from changing over to gas consumption and so putting undue stress on the gas works of the city, the municipal authorities also have raised the gas rates (C. R. 81).

Much of the increased cost in the power stations has been caused by the rapid rise in wages necessitated by the corresponding increase in the cost of living. Nearly all private and municipal enterprises have been compelled to add to their wage scales, and recently it became necessary to increase the wages paid to the employees of the Nottingham tramway corporation, following arbitration by the Ministry of Labor. About 450 employees of the corporation were affected by the decision (C. R. 83).

[1] C. R. indicates "Commerce Reports" of 1918.

Italy has just taken a step that has already been taken by several other countries in the war and that may become necessary in this country. It has made an exact census showing the unemployed machine power of all kinds that may be put to use when needed. The census includes locomotives, boilers, motors, power plants and general power machinery. The forms that had to be filled out by the owners of the machines specified the kind of fuel necessary and the number of workmen employed in running the machines (C. R. 82). Germany made such a census in 1915 and many motors and other power machines have been transferred from parts of the country where they could not be employed to advantage to districts where there was an urgent need.

Longest Transmission-Line Span in World

In a preceding article[2] on this subject, mention was made of the work done on the new power transmission line from Florli to Stavanger in Norway and the erection of the power plant at Florli. The transmission line is now ready, and the power plant will be completed in the near future. In that way 12,000 hp. will be made available for the Stavanger Electric Co. Incidentally, the erection of the transmission line involved crossing the Hogsfjord by a single span of 1514 yd., which is said to be the longest in the world. The span is composed of three cables of crucible steel, since copper or aluminum would not be able to stand the strain. Copper-sheathed cable would have been preferable to prevent loss of voltage, but under present conditions it could not be obtained. Each cable has a diameter of 0.63 in., is composed of 19 strands and has a tensile strength of about 210,000 lb. per sq. in., or a total of about 25 tons for the whole cable. The slack of the cable is 87.5 yd. and in a strong wind it will oscillate 54.7 yd.

The effect of the new installation has begun to show in the neighboring cities, especially in Stavanger and Haugesund, by an increase in the demand for electric installations. Electric current is used quite generally for domestic purposes, and Consul Henry C. A. Dunn, in Stavanger, advises American manufacturers of great sales opportunities in the district (C. R. 104).

Denmark Begins Electrical Development

The rapid development of the natural-power resources of the northern Scandinavian countries also exerts its influence on Denmark. Not only is this country buying electric power from its northern neighbors, but it has also begun to develop some of its own. Denmark has little water power available, and to provide cheap electric power it may become necessary to use the great peat beds. These are situated in the western part of the country and will be developed as soon as the necessary capital can be found. In the meantime steps have been taken to make use of 1000 hp. of water power from the Gudenaa, a small river near Aarhus. The cost of this development is estimated to be approximately $1,000,000, and it will be a year before the plant can be put into operation (C. R. 72).

[2] "Power," Dec. 11, 1917.

Another country which has felt heavily the effect of the war, although remaining neutral, is Switzerland. It is a peculiar fact that Switzerland, having possibly the best natural-power resources of the world for so small a territory, has until recently made very little use of hydro-electric power. For many years gas has been the mainstay for street lighting in many cities. Now the difficulty of obtaining coal has impressed upon the Swiss communities the necessity of making better use of the nearer and cheaper resources at home. So the consumption of electric power is growing rapidly in Switzerland, and during the last year most of the existing stations have reported increasing demands on their producing capacity. The result is that it is now contemplated to enlarge the existing stations and to add a number of new ones in the near future, so as to make Switzerland increasingly independent of foreign coal.

Future Industrial Activity in Spain

After the war, and possibly even now, Spain should attract the attention of our power specialists looking for foreign investments. Spain is an industrially active country which in the future will play a considerable part in the production of many commodities of the cheaper kind. Cheap electric power will be necessary for that purpose, but the numerous schemes now under way may come to nothing owing to the lack of capital. This will have to come from the outside, and America should be able to supply it together with the necessary machinery and equipment.

Vice Consul Asel D. Beeler writes from Bordeaux about the great resources of the Pyrenees. What he says about the French side of the mountain range applies also to the southern side. "The mountain region is supplied abundantly with swift and powerful currents of water, readily adaptable to the development of hydro-electric power, a desirable feature where the coal supply is limited. Many of the industries of the cities in the Pyrenean country, as shoe factories, woolen mills and railways, are now operated by electric power which is abundant in a considerable area of the Midi section. The general development and industrial utilization of electric motive power is more characteristic of the industry in the departments of Basses- and Hautes-Pyrénees where the most railroads, the largest rivers and the most populous cities are."

Developments in French Pyrenees

On the French side of the Pyrenees, on the Ariège River near Las Mijanes, a power plant of an average development of 2500 hp. is being erected. The owner of this enterprise is the Société Métallurgique de l'Ariège which recently bought the stock of the Société Hydro-Electrique des Pyrénées, owning a plant at Castelet with a waterfall 90 ft. high and permitting the installation of four turbines of a capacity of 800 hp. each (C. R. 92)). The company also owns rights to develop power on the Nagear, where there is a waterfall of 1200 feet.

The City of Sofia, in Bulgaria, intends to build an electric central station, although it is doubtful whether American power interests will feel much inclined to make use of an opportunity to extend their connection in that field just now.

By cutting off the usual supplies reaching South America from European countries, the war has forced industrial expansion everywhere in Latin America, with the result that there has been an increasing demand for electric power. This has been supplied by extending existing enterprises and by adding a number of new ones. During the last few months several of the leading power enterprises in South America have made their annual reports, which in each instance seem to show a considerable expansion in power distribution and also increased takings.

One of the most representative enterprises, doubtless, is the Lima Light, Power and Tramways Co., of Lima, Peru. This company reports a gross revenue of $2,142,480, as against $1,986,360 during the year 1916. The net revenue amounted to $964,250. There has been, however, a noticeable rise in the yearly expenses amounting to $76,740. Increased employment of electric power is given as the chief reason for this good showing and also an increase in the tramway traffic. High cost of materials, which in many cases had to be imported from the United States at any price, has added largely to the increase in operating expenses. The company made several extensions of its plant during the year 1917, which included the installation of a 2500-hp. turbo-generator and a 2000-hp. Babcock & Wilcox boiler. New installations have been made at Chosica, Yanacota, Barranco, Chorillos, Miraflores and Lima (C. R. 105).

Increased Rates for South American Plants

In Chile electrical enterprises have been suffering much from the lack of coal. Several Chilean power plants are burning wood, which is cheaper than coal. The scarcity of fuel and its high price have forced most of the power plants in South America to increase their rates, and this action has not always been accepted in a very friendly spirit by the consumers, already exasperated over the high cost of living.

In Uruguay the government has just authorized the governmental power plants to increase their rates. This step is explained to the public principally on the ground of increased cost of fuel. Many Uruguayan power plants, by the way, are burning oil imported from the United States (C. R. 96).

The exceptional activity in the power industry reported from other parts of the world has also been noticeable in eastern Asia and India. In Japan it has found expression in an increased demand for hydro-electric power, which doubtless has been caused by the high prices that had to be paid for coal. The rising operating cost, however, so far has not allowed the hydro-electric power companies to take full advantage of the situation, with the result that so far none of them report materially increased earnings.

In China the electrical industry is suffering a good deal from the lack of new machinery. The demand for new installations is great, but as it is practically impossible to get new machines, repair work and additional construction are much delayed. This condition is leading to an increase in the manufacture of power machinery in China, especially in Hongkong—a piece of news which doubtless will interest American manufacturers. If it should turn out that Chinese and other Asiatic concerns get into the habit of building complicated power machinery in their own plants dur-

ing the war, they may continue the practice after the war, with the result that much trade will be lost to American and European manufacturers of such machinery. This is one of the dangers caused by the present interruption of foreign trade. However, it is not probable that a Chinese machine-building industry much better developed than that which now exists will be able to meet the demand for power machinery which is to be expected from China in the near future. Even with such national competition, therefore, there may be expected a healthy demand from that country after the war.

In both Hongkong and Shanghai, by the way, a considerable increase in takings is reported by the local tramway companies. The Shanghai Street Car Corporation, which in 1909 carried 11,750,000 passengers, is now carrying 73,500,000 per year, and its takings have been trebled. Electrical engineers in China are of the opinion that the future of electrical enterprise is extremely bright. Proposals are now made for a more scientific development of the existing opportunities and also for the creation of machinery which later will allow the linking up of existing systems so as to make them mutually supporting (C. R. 89).

In Madras, British India, there are at present 54 industrial establishments operated by electric power. The total sale of current, which amounted to 5,086,609 units during 1916, has now reached 5,693,807 units, and the increased demand for energy has led to the erection of two new substations. There are today 126 electric plants in operation in the Madras Presidency.

Causes of Vacuum Trouble

By L. F. Forseille

Previous to the application of the little device herein described, considerable trouble was experienced at times in maintaining a normal vacuum on a 10,000-kv.-a. turbine unit equipped with a jet type of condenser.

The small turbine driving the air and removal pumps is loaded to its maximum capacity, thereby affording very little reserve for any additional effort that it might be called upon to exert. After carefully watching its performance, I found a number of causes of the trouble, each being accompanied by a partial loss of vacuum, the extent of this loss being governed by the time required by the attendant to correct the trouble. The most frequent causes were obstructed strainers in the air-pump supply line. These instances were invariably preceded by racing of the pump turbine.

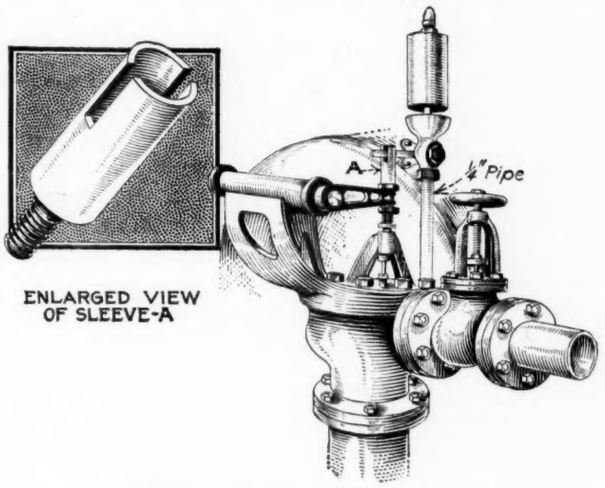
Following is a list and a brief explanation of each of the contributing causes:

Too much injection water being used, thereby overloading the pump turbine.

A sudden reduction of load on the main unit would immediately result in the turbine racing. This I believe can be accounted for as follows: A reduction in load will result in a rise in vacuum, increasing the velocity and consequently the amount of water entering the condenser. This is further augmented by a drop in temperature of the discharge water and an increase in the working head. Summing up the different changes that take place, I believe that the reduction in the amount of steam flowing to a condenser is more than compensated for in the increased amount of injection water, leaving the pump to discharge as much, if not more water, than with a full load on the main unit, and this at a greatly reduced temperature. This latter item must be considered, owing to the fact that the discharge is approximately 18 ft. above the center line of the pump. Of course the only remedy, as in the preceding case, is to cut down on the injection water. Too much water going to the air pump has about the same effect and can be overcome only by cutting down the amount.

Obstructed strainers in the air-pump supply line will cause the turbine to race violently. This, I think, is caused by the pump alternately picking up slugs of water and air. The remedy is to change over to the clean strainers.

Wet steam coming over from the boilers will cause racing and a momentary loss in vacuum, which usually rights itself without any further trouble. However,



ARRANGEMENT OF SIGNAL WHISTLE

in extreme cases it is necessary to cut down on the injection water until the trouble has passed, when it can be gradually brought up to normal volume.

A vacuum leak in any part of the system, including the water-supply line, will also cause racing, and if serious, racing will continue until the leak is stopped. It will be noticed (as I have previously mentioned) that any irregularity in the pump turbine is a sure sign that something is wrong. On the other hand, as long as the turbine is going smoothly one can rest with a fair degree of certainty that this part of the equipment is working all right. This fact became so apparent to the attendants that they formed the habit of watching the governor arm on the pump turbine at all times when not actually engaged in performing their other duties.

The apparatus mentioned in the beginning of this article simply acts as a warning to attendants and can be heard from any part of the turbine room or basement. It consists of a small whistle screwed into the top of the governor valve and actuated by the governor arm (see illustration). It has been in operation about a year, and the results have been most gratifying, so good in fact that the vacuum on this unit has not been lost since from any of the foregoing causes, due to a timely warning and good work by the attendants. It is so constructed that it can be adjusted to sound an alarm whenever the governor arm comes within any desired distance from the stop. The sketch is self-explanatory.

Yarway Adjustable Spray Head

When cooling water for condensing purposes can be obtained from a convenient river or lake, there is no necessity for installing means for cooling it. But when the supply is limited, so that it is necessary to use the water over and over again, artificial recooling must be employed. There are two common methods of cooling circulating water—one by means of cooling towers, the other by means of cooling ponds in which the water is stored after passing through a number of spray nozzles that break up the water that comes to them under pressure.

In Fig. 1 is shown a spray pond[1] the spray nozzles of which are adjustable. They are known as the "Yarway" adjustable spray heads and are manufactured by the Yarnall-Waring Co., Chestnut Hill, Philadelphia, Penn. Details of their construction are shown in Fig. 2. The distinctive feature of this spray head is that it is adjustable with regard to the fineness of the spray obtained at any given pressure. Therefore it can be set to secure the maximum cooling range under any condition of temperature or humidity, for a minimum loss of water by driftage due to wind and for maximum efficiency of partial loads. Because of these features the full area of the pond can be used with all of the nozzles nearly closed, Fig. 1, before it is necessary to cut any of them out of service.

Referring to Fig. 2, the head consists of a cast-iron body *A*, in the top of which a 3¼-in. o. d. bronze tube *B* is secured which carries a cap through the center of which the stem *D* passes. A helical opening of coarse pitch is cut in the tube *B*, the water to be sprayed leaving the nozzles through this slot. The opening is cut at an angle of about 60 deg. with the axis of the tube so that the water is thrown upward at the same angle.

The rod *D* is adjusted to the cap *C* by a locknut *E* and moves in a close clearance brass bushing *F* that is provided in the body casting. A pin in the end of the stem engages a bell-crank lever *G*, pivoted at *H*. The lever end of the vertical arm is attached to the main adjusting rod at *J*. By moving this rod one way or the other, the stem *D* is raised or lowered, thus opening or closing the spiral slot in the cylinder *B*.

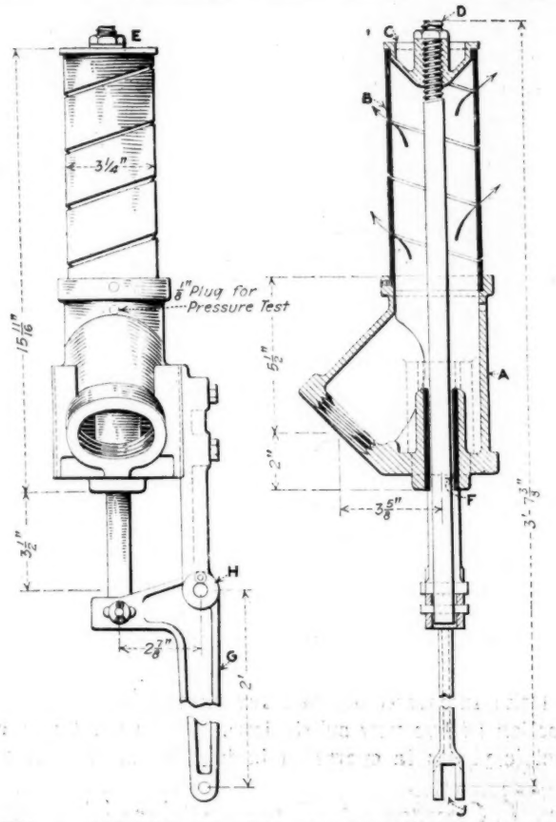


FIG. 2. DETAILS OF THE "YARWAY" SPRAY HEAD

The result of this is to increase or decrease the fineness of the flow of water as it leaves the head. The water is discharged in an upwardly inclined direction in a continuous sheet which becomes finer as it spreads and finally breaks up into a uniformly fine spray or mist, or into a large number of small drops, depending upon the size of the opening to which the head had been adjusted. The method of connecting the spray-head levers to the operating rod is shown in Fig. 3.

As shown in Figs. 1 and 4, the spray heads are secured to branch pipes which connect with a main header, the branches being of succes-

[1]Reproduced by courtesy of Walter Kidde & Co., Inc., engineers and constructors, New York City.

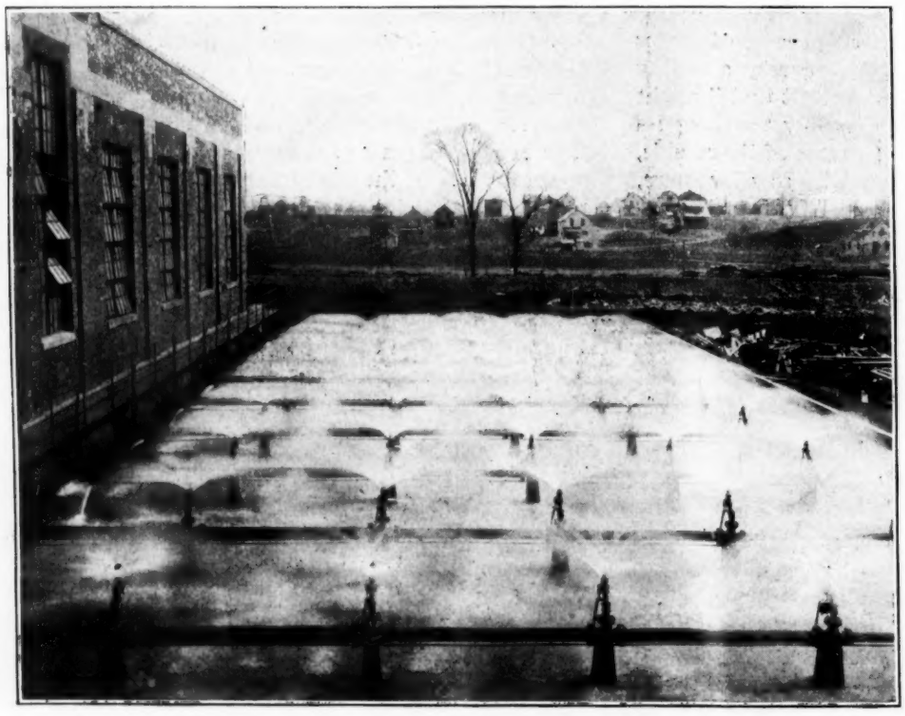


FIG. 1. "YARWAY" SPRAY-HEAD INSTALLATION, HEAD COMPRESSED

sively decreasing diameters. The adjusting lever of each row of spray heads is connected to a main ¾-in. iron pipe, to the end of which is fitted a saw-tooth regulating lever, the saw teeth being for the purpose of holding the rod for any adjustment of the spray head. This lever extends to the shore, and by a pull or a push on it all the heads in that row are either closed or

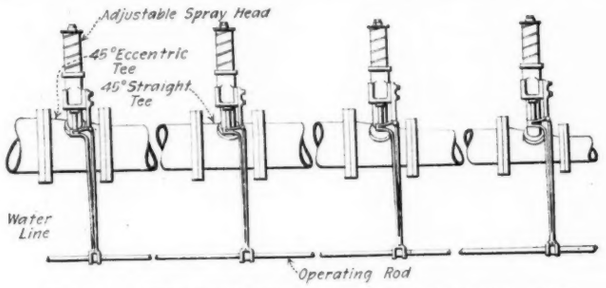


FIG. 3. ARRANGEMENT OF THE OPERATING ROD

opened. These rods can be seen in Fig. 4, where the spray heads are adjusted for a greater spraying capacity than in Fig. 1, where the spray is throttled. The spray pond, Fig. 4, is at the plant of the Moore Steam Turbine Corporation, Wellsville, N. Y.

In Fig. 1 there are shown nine spray heads with a total of 45 spray nozzles. The cooling pond is about 75 ft. wide and 180 ft. long. The main branch is 24 in.

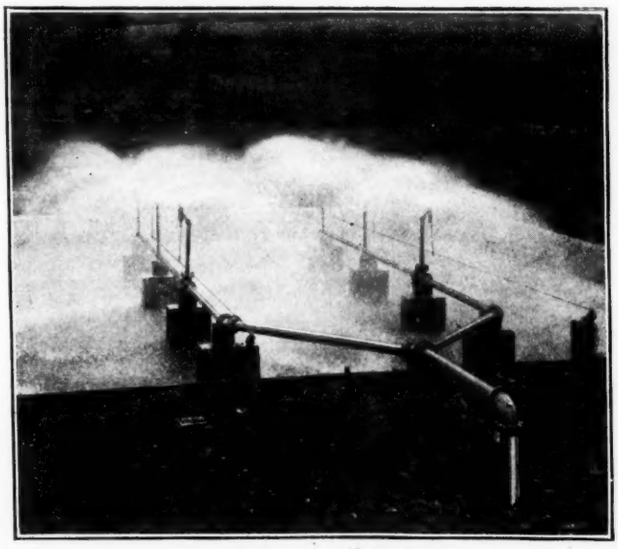


FIG. 4. A SMALL INSTALLATION SPRAYING UNDER NORMAL CONDITIONS

diameter and the branch pipes begin at 8 in. diameter and reduce to 4 in. These 45 spray nozzles with a 23-ft. head take care of the water necessary for condensing the steam from three 750-kw. turbines at the plant of the American Hard Rubber Co., Akron, Ohio, and are sufficient for about 35,000-kw. turbine capacity.

Gas-Engine-Valve Problems

By G. W. Muench

The buying and selling of used gas engines is a business of enormous proportions at the present time. Hundreds of these engines are bought by men who know nothing about them. A demonstration is asked for, the engine runs without knocking, and apparently everything is as it ought to be. Even the man who knows something about internal-combustion motors, however, often gets misled by one serious trouble, the valve setting. The engine may be working very well without a load or with a light load, but will not carry anywhere near full load. There are many possible causes for poor valve settings, such as wrong meshing of the gears; wrong adjustment of the push-rods; worn push-rods, cams, valve stems, gear teeth and other parts of a valve gear. The valve setting of a gas engine is about as follows:

The inlet valve should open 5 to 15 deg. past the inner dead-center and should close from 20 to 35 deg. past the outer dead-center. Exhaust valve should open about 30 to 40 deg. before the outer dead-center and should close at about inner dead-center to 10 deg. past.

Frequently, an attempt is made to make a gas engine develop a greater power than it is designed for, by changing the governor adjustment to allow the engine to operate at a higher speed. This can be done to only a limited extent. After the speed has been reached at which engines will develop maximum effort, the power of the engine will decrease if the speed is increased beyond this point. The reason for this is, the valve can take care of only a certain amount of gas in a given time, since the speed of the gases passing through the valves is limited. There is a difference of opinion as to this limit. One good authority gives the limit of the ingoing gases at 6000 ft. per min. and the exhaust gases 5000 ft. per min. These figures refer especially to stationary engines.

Assuming that the gases in the cylinder travel as fast as the piston, it is easy to figure the velocity of the gases through the valve opening as follows:

$$v = \frac{D^2 V}{d^2}$$

where v equals velocity of gases through valve passages in feet per minute, D equals diameter of cylinder in inches, d equals diameter of valve passage in inches, and V equals velocity of piston in feet per minute.

The foregoing affords a means of finding what approximately would be the speed limit of a particular engine. For example, an 11 x 12 engine having 4-in. valve openings and rated at 300 r.p.m., is to be increased in speed 10 per cent.; that is, to 330 r.p.m. The engine has a 12-in. stroke and is to operate at 330 r.p.m. This is equivalent to a piston travel of 660 ft. per min. In calculating the velocity of the gas in the valve chambers, it is assumed that in the cylinder the gas is traveling at piston speed, in this case 660 ft. per min. Then, by substituting the foregoing values in the formula, the velocity of the gases through the valve opening is

$$v = \frac{11^2 \times 660}{4^2} = 4991\ ft.$$

or approximately 5000 ft. per min.; therefore this increase in speed might be permitted, as it brings the speed about up to the allowable figures for the exhaust valve. Of course other factors enter as to the advisability of increasing the engine speed, especially the safe flywheel speed.

If the speed of an engine is materially changed, it might also be advantageous to somewhat change the valve setting. However, this may not be an easy matter,

since, in many heavy-duty stationary engines the setting cannot be changed. Sometimes both valves are adjustable, but oftentimes only one can be changed. In resetting the valves, it must also be remembered that when a valve is adjusted by changing the length of the push-rods, if the valve is made to open earlier it will close later and vice versa, but if the valves are made to open and close earlier or later by changing the setting of the camshaft gear, all the valves will be affected the same in both closing and opening.

Another interesting valve problem is the division of the cycle according to the valve setting. Since it requires four strokes to complete the cycle of a 4-stroke-cycle gas engine, it is often thought that each performance of the cycle requires one stroke. This is, however, not the case. Take for example, the following setting. Intake opens 15 deg. past inner dead-center, intake closes 25 deg. past outer center; exhaust opens 40 deg. before outer center and closes 10 deg. after inner center. The complete cycle is 720 degrees. The intake opening at 15 deg. after inner dead-center and closing 25 deg. after outer dead-center is an angle of 190 deg., or about 26.4 per cent. of the cycle in suction. Between the closing of the intake and inner dead-center is the compression, 155 deg., or about 21.5 per cent. of the cycle. From dead-center to the exhaust valve opening 40 deg. before outer dead-center is the power stroke, 140 deg., or nearly 20 per cent. of the cycle. From exhaust opening to closing at 10 deg. past inner center is the exhaust stroke, 230 deg., or nearly 32 per cent. of the cycle. From this it is seen that almost one-third of the entire cycle is devoted to exhaust.

Air-Compressor Troubles

By Ray J. Bailey

Some time ago a small motor-driven vertical air compressor was installed in a certain boiler-room where there was considerable dust due to handling coal and ashes. It was necessary to extend the 1½-in. inlet pipe outside of the building. As the unloader *A* was of sensitive construction and as the least bit of dirt would make the pistons stick, causing poor regulation, considerable power was wasted because of the safety valve on the receiver releasing continually.

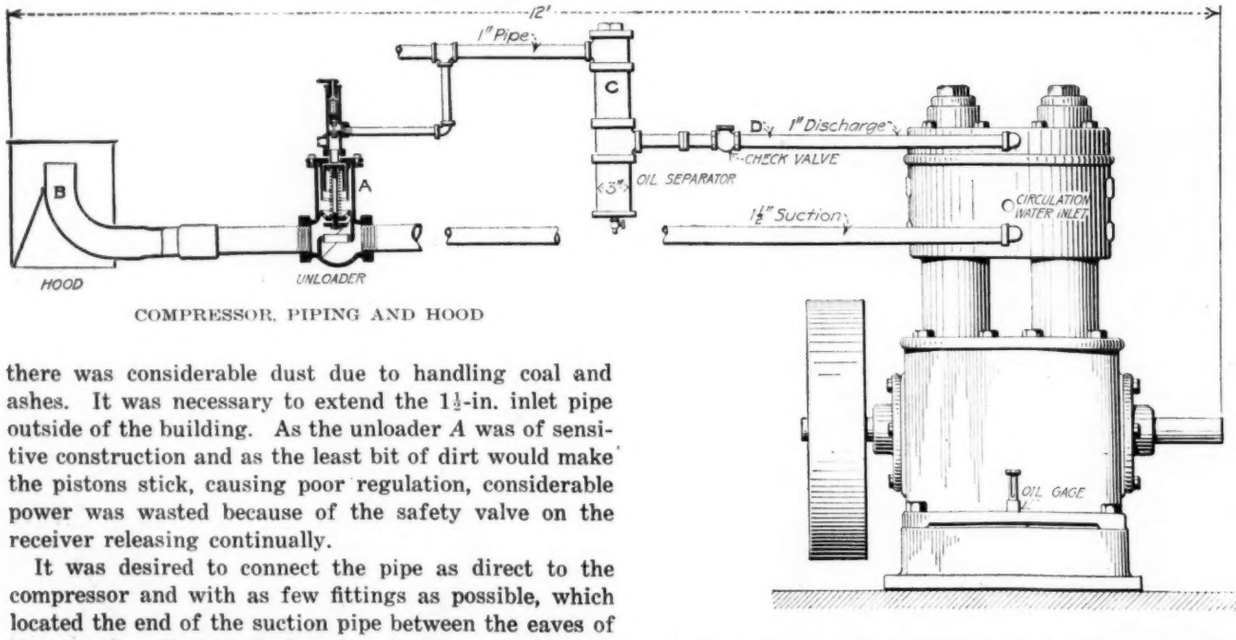
It was desired to connect the pipe as direct to the compressor and with as few fittings as possible, which located the end of the suction pipe between the eaves of three roofs. To keep it free from water and other obstructions, a hood was made, as shown at *B*, from 6-in. galvanized sheet-metal pipe with a 2-in. sheet-metal pipe on the inside soldered to a 2-in. galvanized pipe nipple. These parts were all taken from used material found about the factory. This arrangement has worked satisfactorily for nearly a year, and it has never been necessary to clean out the unloader nor has there been any trouble from poor regulation.

For lubricating the cranks, crosshead pins and pistons, four or five gallons of a certain quality of engine oil was put in the crank case when the machine was first installed. After a few days the oil was found unsuitable for this class of work, because, being thin, it would work past the pistons—which are exposed at the crank end—to the oil reservoir and about one pint per ten-hour run would pass through the valves and discharge pipe, burning on the valve stems and springs and causing them to stick and hold away from their seats. A portion of the burned oil would work into the unloader and make trouble.

An oil separator *C* was made from pipe fittings and two 3-in. nipples, each 6 in. long. A special air-compressor oil was used, and no further trouble has been experienced; less than one ounce of oil gets into the separator in thirty days.

Considerable advantage was gained by using a check valve in the 1-in. discharge pipe *D* when it was necessary to shut the machine down to examine the valves or to do work on the machine under pressure. It also serves to take the strain off the discharge valves due to the hammering effect when closing.

Several swing checks were used, which lasted but a week or ten days before the disk and seat had to be faced off and fitted so they would not leak. A horizontal globe check valve was then used, with the disk guided by a stem above and another below the seat. After being in service about four weeks, an examination showed that the stem and guide under the disk had worn away, the disk and upper stem and guide being in fairly good condition.



COMPRESSOR, PIPING AND HOOD

A check valve of the dashpot type is recommended as the best for this service, in which the upper part of the valve disk is connected to a dashpot, which will prevent its slamming.

Ethics of Sales Engineering

By WALTER G. STEPHAN

A sales engineer represents both the purchaser and the manufacturer, and although it is his business to sell, it is just as consistent with good ethics to counsel against a purchase of his apparatus when conditions are not suitable as it is to advise the purchase of his apparatus when it will supply the needs better than anyone else's. The ethics of salesmanship is discussed from various interesting angles.

THE tremendous industrial expansion in the United States during recent years has brought a most interesting and profitable field of work to the technically educated engineers; namely, the work of the sales engineer. So many new devices and improvements in the various arts have been developed that the manufacturer has gladly called into his organization men with engineering training, who have initiative, confidence in themselves and the ability to persuade others to buy and properly use new things possessing merit. As a result many able young men are successfully following this profession and securing through their work much of the satisfaction that should come to a man through a useful business life.

His Duties Different from Those of the Ordinary Salesman

This army of young salesmen are mostly men who wish to transact business on a sound business basis and who are following a code of ethics of their own which is more or less the result of their previous training and experience. So far as is known, there is no treatise on engineering salesmanship that covers satisfactorily the work of the sales engineer. His duties are sometimes quite different from those of the ordinary salesman. For example, occasionally he has to deal through a consulting engineer, an intermediary between his company and the ultimate purchaser, with whom other salesmen do not come in contact.

Sales experience has gradually formulated a code of ethics regarding the right and wrong way to try to sell first-class power-plant equipment, and this article is an endeavor to provoke a discussion of the subject for the benefit of the selling fraternity as well as the buying public.

The sales engineer represents two parties, each of which is equally concerned in the sale—the purchaser and the manufacturer. And he should be equally concerned to see that both receive fair treatment and that neither is taken advantage of by the other. If there is to be any preference, he should favor the purchaser, for the reason that no obstacles should be permitted to grow up in the path leading from the buyer to the sales office. The door for future business should be easy for the purchaser to open, and he should feel that it is a pleasure for him to open it.

A purchaser is naturally inclined to buy from the seller with whom it is pleasantest to do business. The same line of reasoning applies in the case of the hotel management which uses as its motto in matters of dispute, "The guest is always right." It is not meant by this that the salesman should permit the purchaser to take a great advantage in the transaction, but it is meant that if there is a reasonable question of doubt, the purchaser should be given the benefit of that doubt.

The importance of giving the buyer the benefit of a salesman's experience cannot be emphasized too strongly. It is just as consistent with good ethics for him to advise a prospective purchaser not to buy his apparatus when he knows from experience that the conditions are not suitable, as it is to advise the purchase from the company he represents when he knows he can supply the buyer's needs better than anyone else or equally as well. In fact, it is frequently found that by conscientiously advising a purchaser to buy just the right thing from a competitor, the salesman can and has immensely strengthened his hold upon the buyer's confidence.

His Work Judged by Service Rendered Rather Than by Sales Made

If a salesman is merely interested in selling and is not desirous of performing some real service to society, he will fail to get all he could out of his work. After all is said and done, his work will be measured by the "service rendered" and not by the sales made. The man who is concerned only with making the sale is a mere "peddler," and not worthy of the name of sales engineer. His vision is not broad enough to see the transaction from the viewpoint of the purchaser as well as from that of his firm. He sees only his own immediate remuneration and not his ultimate gain. He should be quick to recommend against a bad purchase and should just as carefully avoid a bad sale. He should seek to carry through transactions that will be mutually advantageous to the purchaser and the manufacturer.

It sometimes happens that, notwithstanding a conscientious recommendation against the purchase of a sales engineer's apparatus, for apparently good and sufficient reasons, conditions obtain later which would have justified the sale. For example, the entrance of the United States into the present war has already changed conditions in many plants beyond the imagination of the most astute business minds. In such instances the salesman can console himself with the knowledge that he followed the dictates of his best judgment.

It sometimes happens that an operating engineer learns that one of the plants in his neighborhood is about to purchase certain equipment. Knowing that a certain salesman's machinery has given him splendid service and wishing to help both his neighbor's plant and himself, he offers to assist in making a sale, provided the salesman is willing to pay him for such service. It is a question of ethics whether it is right to agree to do this. If the engineer can conscientiously recommend the apparatus, he is honestly entitled to remuneration for his assistance in selling. However, it is much better for all concerned not to enter into such negotiations. The danger lies not in this transaction, but in pos-

sible future affairs. Some subsequent negotiation may come up between the engineer's company and the salesman for a purchase, which will embarrass one or the other and will make the engineer feel under some obligation to buy from the salesman whether it be fully to the advantage of his employer to do so or not.

Whenever it becomes necessary for the manufacturer's representative to sell through the office of a consulting engineer, other problems present themselves for solution along ethical lines. It is taken for granted that when a manager employs a consulting engineer to build or extend his power plant, he delegates him to recommend what kind and make of apparatus is to be bought. In other words, he says to the consulting engineer: "I don't know a thing about boilers, stokers, engines or turbines. You do. Tell us what we should buy and see that a plant such as we will need is built."

His Statements to the Consulting Engineer Should Be Perfectly Frank

The consulting engineer, in preparing specifications for bidders, sometimes calls in several sales representatives in order to discuss the specifications with them or the limiting features of his plant and to make sure that the work of the various contracts will join together to make a complete whole.

Under such circumstances the salesman will find a perfectly frank statement from him to be most acceptable to the broad-minded engineer. If he finds that the consulting engineer is making inadequate provisions anywhere or that his apparatus is not suited to the conditions, a free discussion of the matter will be appreciated. To a certain degree the consulting engineer is somewhat analogous to the general practitioner in medicine, and the experienced salesman corresponds to the specialist. He is, therefore, the specialist or one of several specialists. Very few consulting engineers are buying all kinds of power-plant equipment so continuously that they are able to keep strictly "up to the minute" on the latest developments in the art. The salesman is, or should be, one of the best-posted men in his line, with some such motto as this before him:

> "If a cobbler by trade, I'll make it my pride
> The best of all cobblers to be;
> And if only a tinker, no tinker on earth
> Shall mend an old kettle like me."

A salesman should not endeavor to see that the engineer's specifications are so worded as to give him great preference or advantage in the bidding. Specifications should be written so as to exclude such articles as are not suited to the plant and should permit of a choice by the purchaser between not less than three reputable manufacturers, if possible. Honest competition hurts no one, and if an apparatus can't stand on its own merit in fair and open comparison, don't waste time trying to sell it. Life is too short.

Going Over the Engineer's Head

There is great temptation, after specifications have been issued by the consulting engineer, for the salesman to seek an interview with the ultimate purchaser in order to secure additional influence in favor of his equipment. This is commonly called "going over the engineer's head" and, naturally, is resented by him. The only ethical way to proceed, if there is any reason whatever for desiring to talk to the man who will finally sign the order, is to go to the consulting engineer, state the case frankly and take his advice. While in some cases one may be able to secure business by going over the engineer's head, it certainly will not help to get further specifications to bid upon from the engineer's office. Consulting engineers are just as human as are others.

If for any reason it becomes evident to the salesman that he is repeatedly being discriminated against by the engineer's specifications, and he has endeavored courteously on several occasions to dissuade the consulting engineer from this course, then there is no further reason for avoiding an interview with the ultimate purchaser in which can be stated diplomatically but frankly the reasons for taking such a step.

The most difficult problem for the sales engineer is undoubtedly the prospective sale to a municipality. Most men "hate a municipal job." The reason for this is that so many incompetent persons are usually concerned with the municipal purchase, and so many conflicting interests are involved, that there is no reasonable probability that the best bidder will get the contract. Boards of public service composed of several men and sometimes councilmen in addition, interest themselves in a large contract for power equipment—and very properly so—but they do not leave the decision as to the technical merit of differing bids to the proper person, namely, their engineer. Consequently, there is frequent accusation of graft in connection with the public letting of contracts. It is believed, however, that there is, at the present time, very little of the old-time "grafting" for the very good reason that a higher code of ethics obtains among both public officials and salesmen. Engineers in public office are showing a commendable courage in writing specifications so as to permit only those who manufacture suitable apparatus to bid. It is a weakness on the part of an engineer to write specifications so open that anybody and everybody can bid. It is a confession of his inability to specify.

The Sales Engineer Should Be Governed by a Sense of Public Duty

Furthermore, it is wrong to encourage a manufacturer to spend the time and money necessary to make up a bid when he has no chance whatever to benefit by it. Therefore, a salesman should urge engineers to limit the bidding to manufacturers of suitable apparatus even though by so doing he excludes his own company from bidding. Let him be prompted by as fine a sense of public duty as he can muster in matters that concern the American municipalities and frown down all attempts to misappropriate public funds.

Finally, let him bear in mind that the work that he is doing is a splendid work of education and that he is really doing pioneer service by educating able, wide-awake managers and engineers to practice better economies in natural resources, in labor and in time. Let him also uphold the dignity of his profession by giving fair and courteous treatment to others and by insisting upon fair and courteous treatment himself.

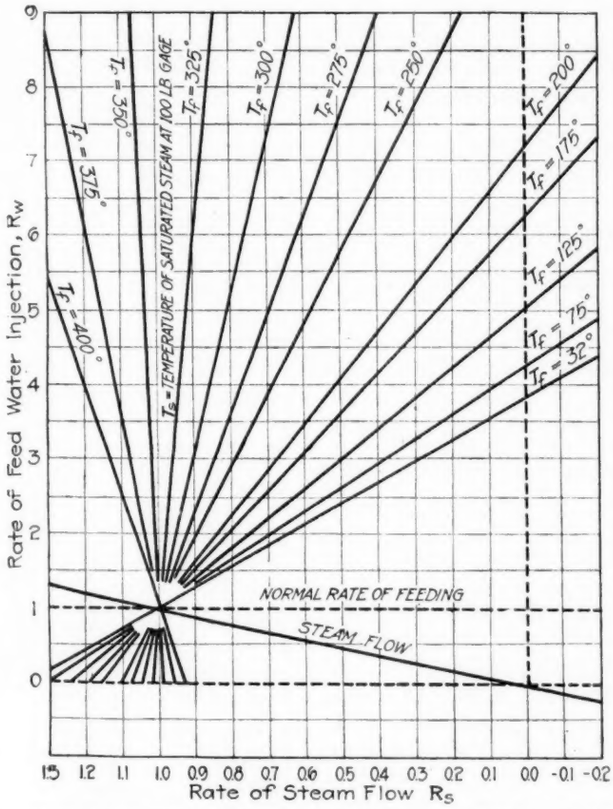
The remarkable effect of the buying of War-Savings Stamps has been the development of a finer sense of thrift and economy among the people.

Effect of Feed-Water Temperature and Rate of Injection Upon Steam Flow

By FRANK G. PHILO*

The author has plotted an interesting chart showing the effect on steam flow of the feed-water temperature and rate of feeding. Under any given condition the actual output of the boiler, expressed in B.t.u. absorbed per unit of time, is constant regardless of the rate of feeding and the temperature of the feed water.

INTERESTING data upon the changes of rate of steaming due to varying rates and temperatures of feed-water injection are shown upon consulting the steam tables and plotting results in graphical form shown by the chart accompanying this article. Under any given condition the actual output of the boiler expressed as B.t.u. absorbed per unit of time is constant, regardless of the rate and temperature at which the boiler feed water is injected. However, boiler output expressed in pounds of steam per unit of time varies widely with changing feed-water temperature and rate of feed-water injection, being highest when no water is being fed to the boiler and lowest when the feed-water temperature is very low and the water is injected at a high rate. When the feed water is fed into the boiler at the same rate at which the boiler is steaming, the normal condition will be considered to exist and the amount of water in the boiler will be constant. Any rate of feed-water injection above or below normal will increase or decrease the rate of boiler steaming and the amount of water in the boiler. Shutting off completely the supply of feed water will appreciably increase the rate of steam flow. On the other hand, any increase above the normal rate of feed-water injection will reduce the rate of steam flow; in fact, if the water is fed fast enough, steam flow will cease entirely. A still greater rate of injection will cause a reversal of steam flow from the line if the boiler is not equipped with nonreturn valves. If nonreturn valves are used, the pressure on the boiler being fed at this abnormally high rate will drop below line pressure. The aforementioned effects are most noticeable when very cold water is used and when the rate of steaming is low. An interesting example of the reverse effect of temperature of feed water is in cases where economizers are used and the temperature of the feed water is equal to or greater than, in some cases, the temperature of water in the boiler.[1] When the feed temperature is the same as the temperature of the feed water in the boiler, feed-water injection does not affect the rate of steaming. When the feed water is actually higher in temperature than that in the boiler, an increase in steam flow occurs upon feeding water into the boiler. The following formulas and the



EFFECT OF FEED-WATER INJECTION ON STEAM FLOW

*Chief Engineer, Station A, New York Steam Co., New York City.

[1] Possible, due to the higher water pressure in the economizer.

Feed Water Temp., Deg. F.	B.t.u. at 100 Lb. Gage H	L	h	Rs, Rate of Steaming: 0.20	0.00	0.20	0.40	0.60	0.80	1.00	1.20	Rs When Rw Is Zero
				Rw, Rate of Feeding								
32	1,189	880	309	4.41	3.84	3.28	2.71	2.14	1.57	1.00	0.43	1.35
50	1,171	880	291	4.63	4.03	3.42	2.81	2.21	1.61	1.00	0.39	1.33
75	1,146	880	266	4.97	4.31	3.64	2.99	2.32	1.66	1.00	0.34	1.30
100	1,121	880	241	5.38	4.65	3.92	3.19	2.45	1.73	1.00	0.27	1.27
125	1,096	880	216	5.89	5.07	4.24	3.44	2.63	1.81	1.00	0.19	1.24
150	1,071	880	191	6.53	5.60	4.68	3.76	2.84	1.92	1.00	0.08	1.22
175	1,046	880	166	7.36	6.30	5.24	4.18	3.12	2.06	1.00	.....	1.19
200	1,021	880	141	8.49	7.24	5.99	4.74	3.49	2.24	1.00	.....	1.16
225	996	880	116	10.10	8.59	7.06	5.55	4.03	2.50	1.00	.....	1.13
250	971	880	91	12.60	10.67	8.73	6.81	4.87	2.93	1.00	.....	1.10
275	946	880	66	16.91	14.36	11.66	9.00	6.33	3.66	1.00	.....	1.07
300	921	880	41	26.76	22.46	18.17	13.88	9.58	5.26	1.00	.....	1.04
325	896	880	16	67.00	56.00	45.00	34.00	23.00	12.00	1.00	.....	1.01
				Rs, Rate of Steaming: 1.00	1.20	1.40	1.60	1.80	2.00		Rs When Rw = Zero	
				Rw, Rate of Feeding								
350	871	880	—9	1.00	20.55	40.11	59.64	79.22	98.77		0.99	
375	846	880	—34	1.00	6.18	11.36	16.54	21.71	26.89		0.96	
400	821	880	—59	1.00	3.98	5.96	9.94	12.92	15.90		0.93	

accompanying chart and table will show the magnitude of the foregoing effects.

H = Total heat above feed-water temperature of one pound of steam;

L = Latent heat of one pound of steam under given conditions plus B.t.u. for superheating one pound of steam (if superheated):

h = Heat of feed water from feed temperature to boiler temperature;

R_s = Rate of steaming;

R_w = Rate of feed-water injection.

1. With feed water shut off entirely, $R_s = \frac{H}{L} = 1 + \frac{h}{L}$.

2. The rate of feed-water injection that would decrease steam flow to the rate R_s would be $R_w = 1 + \frac{L - R_s L}{h}$.

3. The rate of feed-water injection that would cause steam flow to cease, $R_w = 1 + \frac{L}{h}$. (R_s = *zero.*)

4. Under any given condition the sum of the heat absorbed by the feed water and the heat used in boiling the water equals the total heat, or H absorbed by the boiler. As a formula this would be written $R_s L + R_w h = H$.

For examples of the foregoing take the conditions of 100 lb. gage, saturated steam, and 60 deg. F. feed-water temperature. Then $H = 1189 - (60 - 32) = 1161$ B.t.u.; $L = 880$ B.t.u.; and $h = 281$ B.t.u.

1. $R_s = \frac{H}{L} = \frac{1161}{880} = 1.32$, the rate of steaming with no feed.

2. Let $R_s = 50$ per cent., then $R_w = 1 + \frac{L - R_s L}{h} = 1 + \frac{880 - (0.5 \times 880)}{281} = 2.57$, the rate of feed required to reduce the rate of steam flow to 50 per cent. of normal.

3. $R_w = 1 + \frac{L}{h} = 1 + \frac{880}{281} = 4.13$, the rate of feed required to stop steam flow.

As shown by the table and chart, variable feed-water injection with a steady load is disastrous to uniform steam pressure. Variable steam pressure, in turn, causes juggling of fires and short periods of loafing with consequent loss in efficiency of boilers and auxiliaries. However, with loads that have a periodic fluctuation, as in rolling mills, variable feed-water injection, if properly handled, aids the maintenance of the steam pressure. When the load is high the feed is decreased, and as the load drops the feed is increased, utilizing the heat absorbed by the boiler and admitting of fairly constant furnace conditions. This condenser action or heat-storage effect of the feed water is quite appreciable and is taken advantage of by intelligent water tenders. The matter of correct boiler feeding in the majority of cases is not given the attention it deserves, as the results of improved methods of boiler feeding are felt in the operation of the whole station as well as in the size of the coal pile.

The Fuel Administration points out the serious fuel shortage; careful feeding of water to boilers has its share in making up for this shortage of 80 million tons.

Reminiscences of a Boiler Inspector

By R. E. McNamara

While on the road making boiler inspections in the usual way, I once mailed a form card to a certain boiler user, giving notice of my intended visit, and designating the boilers I desired prepared for internal inspection on a certain date, about seven days later. I named a legal holiday and took special pains to see that nothing should interfere with my plans.

Arriving in the village in the evening I called up the superintendent of the plant and asked him if he had received my card and if the boilers would be ready, also if the plant would be running next day. He said that the plant would be running next day as usual notwithstanding the holiday, that the boilers were hot and could not be spared, that he had received my card, but that no arrangements could be made for inspection at that time. I therefore decided to make an external inspection only, so I walked out to the plant next morning, giving myself just about time enough to make an external inspection and catch the morning train. Passing the office of plant on the way, I dropped in. The superintendent was in, and I recalled the telephone conversation of the previous evening, remarking that as it was then only about 7 o'clock perhaps the engineer was not yet at the plant, but was told that the engineer was there and that there would be no trouble in getting in. Arriving at the plant imagine my surprise at finding that the group of boilers I especially desired to inspect were not only not hot, but had been idle for two months. The plant was not running, and there was not a man excepting the watchman to be on the premises that holiday. I routed the engineer out by telephone, and after his arrival he informed me that if he had known of my visit, the two remaining boilers could have been cooled off for inspection as well as not, for they were simply kept warm for emergency.

It is hard to imagine a superintendent, in daily and actual contact with a plant, not knowing more of the details than that. My first and very strong thought was that he had deliberately ignored my card and wilfully misled me in his statements, for it does not seem reasonable that any sensible and intelligent man could or would try to give plausible excuses for apparent contradictions of this kind. From what I afterward learned, however, I am convinced that he was honest in his statements and that it was a peculiar combination of circumstances that need not now be entered into that caused him to tell me what were in reality misstatements and grossly erroneous answers to my questions. Marvelous is the product known as human nature.

At another time, I recall, the date for the internal inspection of a plant had been set for a certain Sunday; that is, we had mailed the owner a card giving that date, for we knew that Sunday was the regular washout day. Arriving at the plant (which was about four miles from the regular path of travel, requiring a livery rig to reach it), I found the place locked up, with high brick walls all round and no apparent mode of entrance. Scouting around the neighborhood, which was new to me, no information concerning the superintendent or engineer could be had. Returning and walking around the premises again, I noticed that the cleanout door of the combustion chamber opened directly to the com-

mons or field and that the combustion chamber had been cleaned that morning or at least very recently.

Not wishing to lose the time and trip, I made a change of clothes in the buggy, opened the combustion-chamber door and took the risk of being able to crawl over the grates into the boiler room. Fortunately, no trouble was experienced and entrance to the engine and boiler room was easy. The top manhole was open and a ¾-in. hose was pouring city water into the boiler which, from the appearance of the floor, had been washed that morning, and judging from the small amount of water in the boiler the cleaners had just left. I drained the boiler, made the inspection and thought to myself what a joke it would be on the management when they discovered what I had accomplished and how. I replaced the hose, turned on the water, crawled out, cleaned up the best I could and returned to the city.

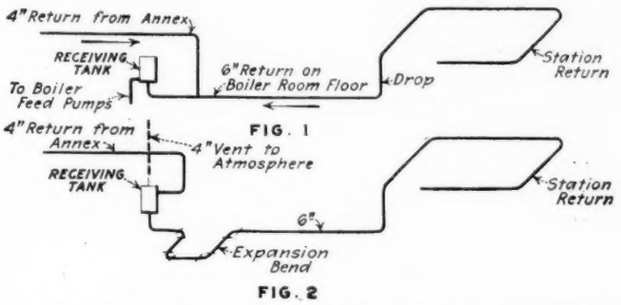
I suppose my readers expect me to relate how I chalked my name on the inside of the boiler as proof or left my card in a conspicuous place to indicate my visit. I regret that this oversight came very near leading to serious complications, for it transpired that the management had not received the notification card and when the internal report reached them, they referred back to the date and at once notified the company that it was impossible for an inspection to have been made for the plant and boiler house were locked up and although it was true that the boiler had been washed on that date, the engineering force had seen nothing of the inspector. My company at once referred the matter to me, and I then saw what a mistake I had made, for it was not at all likely that, ordinarily, one would have used the method and made the inspection as I did, and it was equally as improbable that anyone else could be made to believe that I had resorted to this expedient. I suggested in my letter containing a full statement of the case that the livery-stable driver might add his testimony if asked. I never heard more of the incident other than a warning from my company which at least indicated a doubt on their part. Since then, whenever I find myself in a plant alone or without witnesses when an inspection is made, as a precautionary measure I post my card as proof of my presence. I doubt very much, however, if I will ever again make such a back-door entrance to make a boiler inspection.

Heating System Returns Connected Wrong

By T. W. Reynolds

Connecting heating-system returns as shown in Fig. 1 caused considerable difficulty in a certain large railroad station. There was a 6-in. return from the station proper and a 4-in. return from the express company annex, the 6-in. main running under ground all the way around the building to drain the various radiators. Its elevation was somewhat above the receiving tank except for the portion that ran along the boiler-room floor to connect with the receiving tank. Radiation in the annex is overhead, and the 4-in. return from these coils is also overhead and at a considerably greater elevation than the 6-in. return to which it is connected at its lowest point near the receiving tank as shown in Fig. 1. The boiler-feed pumps take their suction from this tank, 3 ft. 6 in. in diameter and 5 ft. high. Any necessary makeup water is admitted to the tank by means of an automatic feeder. Steam is circulated throughout the heating systems without interference; that is, there are no steam traps or automatic valves on the returns and there is therefore practically the same pressure in the return as in the supply.

The annex is a narrow, low building about 500 ft. long, the front of which is practically all doors, so that during the rush hours from 4 to 6, morning and afternoon, these doors are all opened and the heating requirements are greatly increased. Because of this demand for steam the pressure is lowered, consequently the condensate does not flow back freely when retarded by the higher pressure within the station return. This resulted in flooded radiators with hot water as a heating medium rather than steam and at a rapidly decreasing temperature. Therefore, when most needed, the heating system failed to heat the annex. Furthermore, the



FIGS. 1 AND 2. CHANGES IN RETURNS FROM TWO BUILDINGS

Fig. 1—Returns join before entering receiving tank. Fig. 2—Return lines connected to tank separately

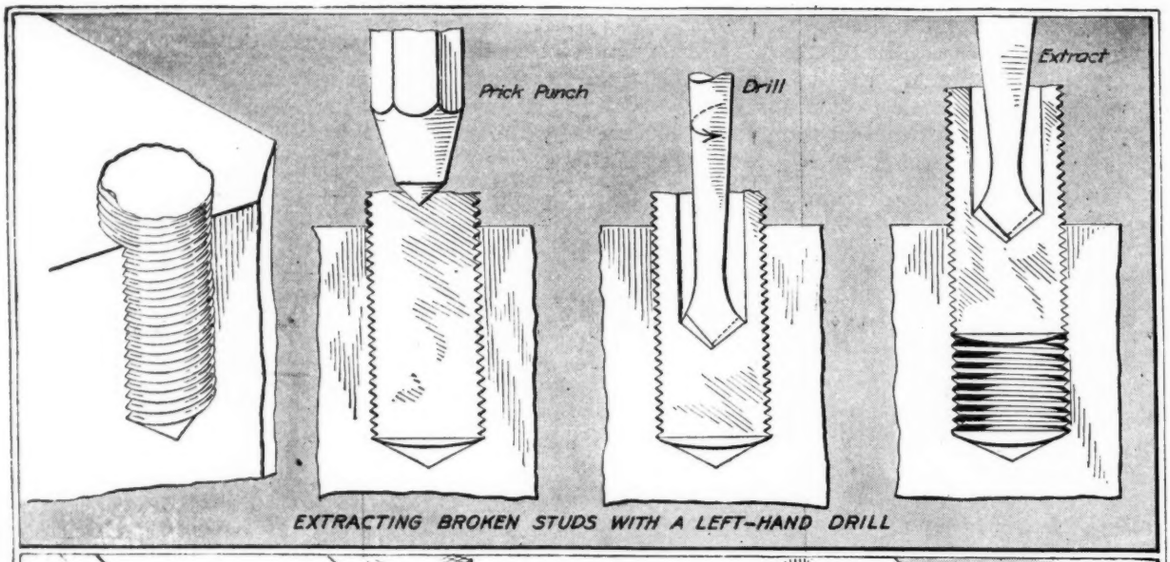
flooding extended to the lower portion of the station return until the static head in the 4-in. return balanced the greater steam pressure in the 6-in. main. Later, the flow of condensate surging back to the tank would cause it to overflow and waste through a pipe leading to a sump. This sump contained a cellar drainer of insufficient size for such large quantities of water, so that the boiler-room floor was soon flooded.

Under such conditions the colder water from the annex mingling with the hotter water from the station created extreme water-hammer, sometimes extending to remote points within the building, and the movement of the 6-in. return caused a considerable stress. The water-hammer was greatest at the receiving tank and was of such force as to cause alarm; the brick foundation under the tank cracked and spread; fittings and joints leaked or were cracked, requiring frequent renewals.

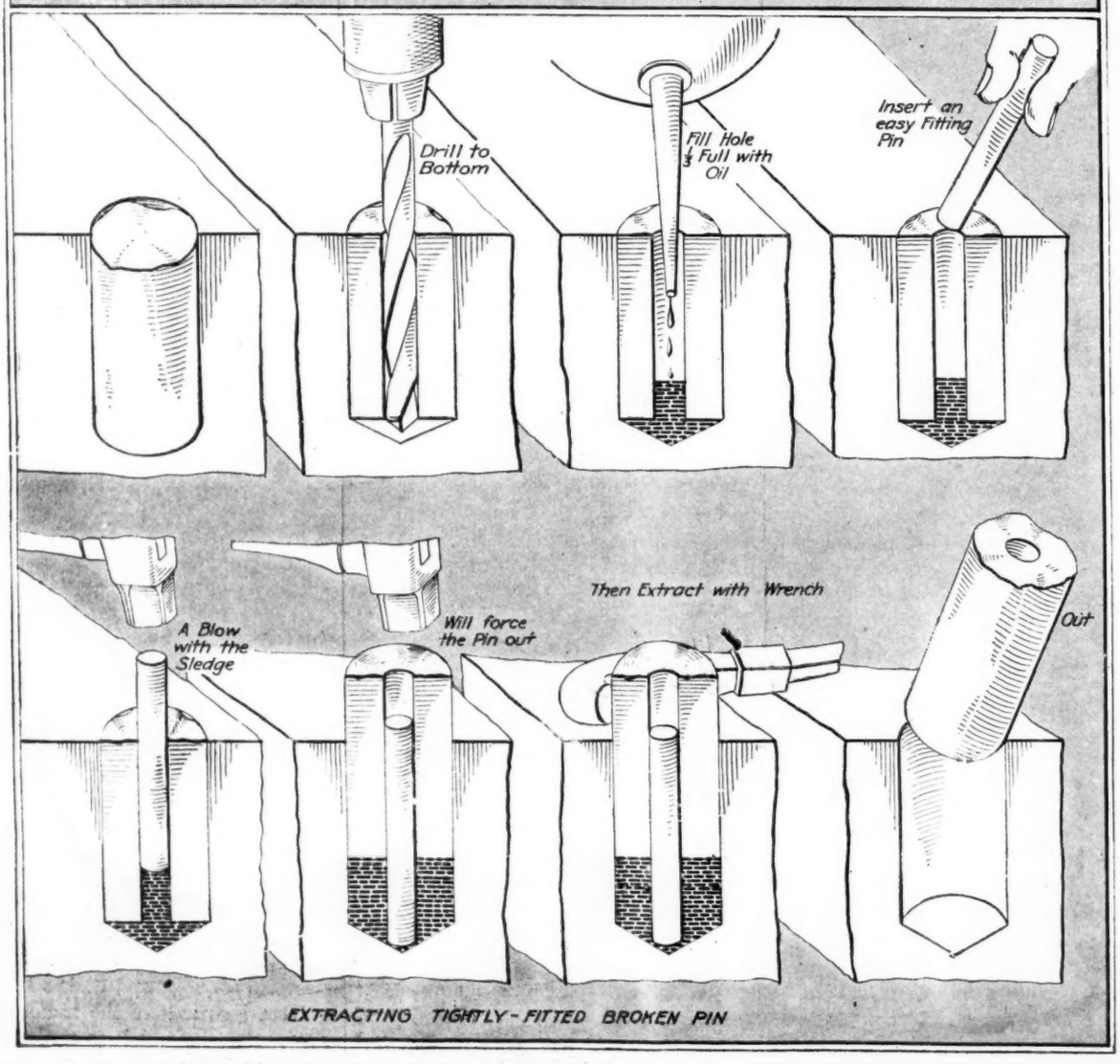
The remedy was simple and was made as shown in Fig. 2. An expansion loop of four ells was placed in the 6-in. return; the brick foundation under the receiving tank was replaced with iron-pipe standards flanged to the floor and tank. The two returns were connected separately into the tank, the one from the annex near the top, the other, as before, at the bottom. A 4-in. vent was run from the tank to the atmosphere, relieving the back pressure that slowed up the returns and the water-hammer was eliminated.

From an Engineer's Notebook

By M. P. Bertrande



EXTRACTING BROKEN STUDS WITH A LEFT-HAND DRILL


Drill to Bottom
Fill Hole ⅓ Full with Oil
Insert an easy Fitting Pin
A Blow with the Sledge
Will force the Pin out
Then Extract with Wrench
Out

EXTRACTING TIGHTLY-FITTED BROKEN PIN

Editorials

The Vanishing Factor

THE average steam boiler under pressure possesses about as much potential power for destructiveness as a healthy deep-sea mine in the heyday of its existence, and frequently it lets loose all its energy on apparently smaller provocation than would disturb a mine of normal temperament and placid disposition. To offset this tendency toward unexpected and undesirable scatteration, we have adopted the plan of building our boilers with what we call a factor of safety—otherwise known as a factor of ignorance.

Under the circumstances, this procedure is the best that can be devised. We are not absolutely sure that every inch of the steel we use in the construction of the shell has the same characteristics as the test piece. We are not at all certain that the pressure for which the vessel is designed will not be exceeded considerably. Our knowledge of the stresses induced in the shell material by the methods of construction and the heat of the furnace is not so exact as we could wish. So we wrap up all our uncertainties into one package, label it "factor of safety," make everything five or six times as strong as the maximum shown by our calculations and trust that we have made the ante sufficiently high to forestall annoying consequences.

Too often our childlike confidence is shamefully betrayed. But when the coroner has completed his investigation and we have managed to collect the widely distributed pieces of boiler and examine them, we are usually a little better informed as to what causes boiler explosions.

Of course, we know at the outset that the sole cause of boiler explosions is the disappearance of the factor of safety, leaving no margin between the load on the shell and the power of resistance. The great trouble is that we are not yet clever enough to catch it in the vanishing act in all cases. Careful periodic inspection frequently detects it gumshoeing into oblivion, but it still has a tantilizing way of taking French leave.

However, we are considerably wiser than we used to be, for we know to some extent why and where the disappearance occurs. Plenty of explosions have their beginning in cracks along riveted seams. We have discovered, through careful and methodical tests, that when a strip of metal having a transverse hole in it is subjected to tension in the direction of its length, the tensile stress at the edges of the hole may be two or three times as great as the average tensile stress in the full cross-section of the strip.

The drilled plates of a riveted joint are similar to the test bar just mentioned, and we are led to suspect that the cracks which develop into disastrous failures have their beginning in minute fractures along the edges of the rivet holes, due to excessive stresses at these points. If we admit that these extraordinary stresses are perhaps twice as great as that considered in our average calculations, we say farewell to half of our adopted factor of safety on the instant.

In a boiler there is a breathing action due to the change of pressure with the periodic drafts of the engines or changing conditions of service, resulting in what are called repeated stresses. The shell is thus subjected to a series of changes of load, varying between fairly wide limits, and we know from the results of tests on iron and steel that a specimen subjected to a considerable number of alternately varying stresses, even though all of them are within the elastic limit, will eventually fail at a stress having a value of only half or two-thirds the normal strength. Therefore, under the long-continued increase and decrease of pressure of a boiler, a point may be reached where the resistance of the material is reduced to half of what might ordinarily be expected of it, and immediately another considerable fraction of our factor of safety evaporates into thin air.

We have made the discovery that caustic soda has an embrittling effect on mild steel such as is used in boiler construction, this action resulting apparently from the occlusion of hydrogen in the metal. Caustic soda forms a very common agent for the treatment of feed water, and if it is present in the boiler we may expect it to have some effect on the steel under favorable conditions. This embrittling renders the metal less able to withstand the loads put upon it. And so our factor of safety takes a further decline.

Considering these points—and they are far from being a complete catalog of the influences affecting the strength of a steam boiler—we begin to appreciate the reason for the reduction of the factor of safety. The unfortunate part of the whole matter is that we have had to obtain so much of our knowledge of the causes of explosions from costly experience; but, after all, that is exactly how the world has accumulated most of the facts it now possesses.

Camouflaged by Coal Conservation

EVERY good American will applaud the untiring efforts of the United States Fuel Administration to conserve the coal supply, even though the means suggested for the attainment of this end may put him to inconvenience and expense. He realizes that by subordinating his own likes and dislikes he is patriotically doing his share to further the common cause.

On the contrary, he is entitled to voice his disapproval and make an emphatic protest when he sees a ruling of the Fuel Administration made an instrument for building up one group of interests at the expense of another, in violation of all the laws of fair play and with little or no regard for the spirit of the ruling.

Charles E. Stuart, chief of the Power and Light Division of the Fuel Administration, has announced a series of plans for the saving of coal, foremost among which is placed the elimination of uneconomical isolated

plants. Elaborating on this particular topic, Mr. Stuart says:

> The individualistic way in which fuel is now consumed in cities is not efficient. A ton of coal burned in a large central station will produce at least four times as much electric power as if burned in the average small plant, and if centralized burning could be introduced to a greater extent, the amount of fuel required could be reduced without reducing in any way the ultimate production of light and power.

No one denies that the central station is able to produce a kilowatt-hour with a smaller expenditure of coal than the small plant; but that is far from being the whole of the story. Electrical power is only one of the products of the heat energy in coal. There is a trinity of such products—heat, light and power—and all three are essential to human comfort and industrial existence.

If the people of this country were like a race of moon-dwellers, capable of enduring the rigors of winter without discomfort, then there might be a general shutting down of isolated plants. But so long as heating is required, just so long will the isolated plant for combined heating and electric generation have undisputed sway in a field in which the central station, with all its vaunted efficiency, cannot successfully compete.

Continuing, Mr. Stuart says:

> It is sometimes the case that in buildings where there are electric plants and where exhaust steam is utilized in the heating of the building and in furnishing hot-water requirements, central-station service can be adopted without a loss of money and at a saving in fuel.

This statement is diametrically opposed to all the results of experience in isolated plants using exhaust steam for heating. It is so completely at variance with the facts that it denotes either astounding ignorance of the subject or a deliberate attempt to distort the truth. In either case it stamps its author as an inaccurate spokesman for a Governmental department whose avowed purpose is to deal intelligently with the coal-conservation problem.

The Fuel Administration has repeatedly stated its intention to impose a minimum of hardship in enforcing fuel conservation. The wholesale shutting down of isolated plants and the compulsory substitution of central-station service would not only be a gross repudiation of that policy, but it would be a national disaster.

The oft-repeated assertion as to the splendid efficiency of the central station resulted in a passive acceptance of the statement. The popular mind became largely obsessed with the belief, just as it took for granted the much-heralded efficiency of the German. But, just as Teutonic efficiency has been shown to be a ridiculously overrated quality—in some cases even a negative quantity—so the preëminence of the central station has been found to exist largely as a state of mind rather than as an engineering fact.

The truth of the matter is that central-station service increases the coal consumption and the expense in any plant that has use for exhaust steam. From the viewpoint of coal conservation, the universal adoption of central-station service would be a huge and costly joke, and the country is in no mood for that sort of diversion at the present time.

The Fuel Administration, probably unwittingly, is in danger of being used by the overzealous henchmen of the central station as a bludgeon to beat the isolated plant into a condition of permanent coma. The isolated plant is painfully aware of its economic weaknesses. It is equally aware of its strong points, and it is well fortified with facts to meet the open onslaught of the central station. But it is at a decided disadvantage in a conflict in which its adversary skulkingly takes refuge behind the bulwark of the Fuel Administration and snipes away like a boche sharpshooter ensconced behind a crucifix.

Those Devil-Hounds

THE hearts of all unhyphenated Americans have been thrilled on reading the accounts of the splendid showing made by our troops in France under the conditions of open warfare brought about by the recent German offensives. It is a style of fighting to which they are adapted by both training and temperament. It makes the conflict a contest of individual skill and courage, in which the American soldier asks no odds of any adversary.

The dash, the intrepidity, the disregard of danger and punishment displayed by the marines in their engagements on the western front heartened and cheered the battle-weary troops of our Allies and electrified the spirits of our people at home. The effect went even farther than that. It taught the boche a wholesome respect for the new fighting element, which the German high command had hitherto affected to regard with sneering contempt; it proved, even to the wilfully blind and thickheaded Teutons, that the forces arriving by the hundreds of thousands from the western world constitute a factor that must be taken into account in the final reckoning; and it earned for those fearless fighters the German appellation of "devil-hounds."

The epithet thus applied becomes a title of merit when interpreted as shown by the artist in the colored supplement to this issue. The marines are hounding and harrying the German beast, and its snarls of rage and hate indicate all too plainly that it has felt the fangs of its tormentor.

It is this beast—the incarnation of all things unspeakable and devilish, glutted with conquest and lusting for further outrages—that stands as a hideous menace to the freedom and happiness of the peoples of the world. For the safety of the generations yet unborn it must be cowed, driven back, overwhelmed and slain. Our marines have splendidly begun the mighty task. Our swiftly arming millions will gloriously finish it.

In history there is one example of physical force, of military might, becoming so strong that nothing but force could overcome it. The Roman Empire reached that stage. It was not conquered; it died of rot; it wrecked itself in the decay of the Middle Ages. The works of civilization of the past were stamped under the oppressor's foot and the world relapsed into barbarism and darkness that lasted during the centuries of the Dark Ages. The world now faces a similar situation; and to prevent it, the military might of Germany must be crushed; otherwise it will die by slow rot, ever so much slower than the Roman Empire because of the science and technique of the oppressor.—*P. B. Noyes, Director Conservation Division, United States Fuel Administration, at annual dinner of the National Electric Light Association, Atlantic City.*

Correspondence

Using a Pitot Tube

Referring to the articles on pitot tubes on page 195, Feb. 5, and page 520, Apr. 9, there are graphic methods often useful for reducing the data to the average velocity head. One method that shows directly the locations in the cross-section of the pipe where it is desirable to take readings near together, for the sake of accuracy, and that gives each observation its proper influence on the result, may be explained as follows:

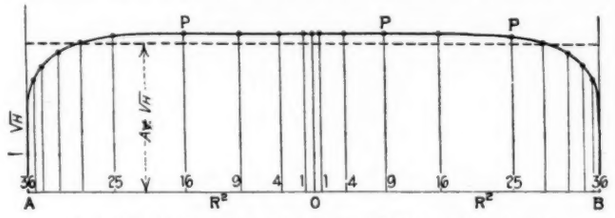


CHART SHOWING AREAS PROPORTIONAL TO FLOW IN PIPES

Since the volume passing a given section is the product of the area of the section and the velocity, these factors being πR^2 and $\sqrt{2gH}$, a plot laid out with values of R^2 and $\sqrt{H}$ as coördinates gives an area that is proportional to the flow. In the illustration, representing a flow of air, O represents the center of the pipe and readings H are taken by the pitot tube at known distances R away from the center across the diameter. Then each reading gives a point P located by laying out the distance R^2 from O along the base-line, and erecting $\sqrt{H}$ as an ordinate. The distance $OA = OB$ is the square of the radius of the pipe. The closed figure formed by the line joining points P and the base-line has an area proportional to the flow, and the average $\sqrt{H}$ is found by dividing this area, as found by planimeter, by the length AB.

The method is somewhat longer than the one in which the average pressure is found from concentric rings of equal area, but additional points are more readily represented. C. H. CHASE.

Stoneham, Mass.

Charged Steam Pipe

H. S. Whitney's letter, "An Electrical Phenomenon," published in *Power*, Feb. 12, and Dr. K. Becker's comments on this letter, in the issue of Apr. 23, bring to mind a somewhat similar experience with static electricity caused by a steam leak.

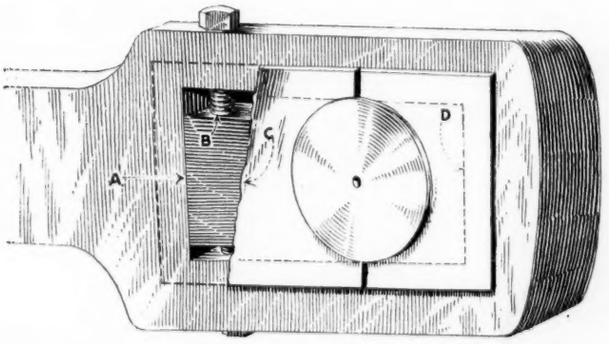
In a plant in which I was working it became necessary to install a supporting strap on one of the steam pipes. A steam fitter went up on a ladder to do the job, but on touching the pipe with a tool, he received a shock that almost knocked him down. As a temporary measure of relief a copper wire was connected between the charged-pipe section and a water main, so that the electric pressure could not accumulate as a charge. Later, a careful inspection was made for a contact between some live wire and a pipe or iron part of the building, but no such contact could be found.

The cause of the charged condition was not discovered until a week or ten days later, when a steam leak in the affected section was stopped; after repairing the leak, the charged condition no longer existed. The blowing of steam through the leak generated the electricity, which, ordinarily, could not have accumulated as a charge, because in most cases it would have followed the pipe line to ground. In this case, however, the pipe line had been installed a long time, and the joints on both sides of the affected section acted as insulation by virtue of rust and the intervening rubber gaskets between the flanges. E. C. PARHAM.

Brooklyn, N. Y.

Engine Broke Wedge Bolts

The crosshead ends of the connecting-rods of some of our engines are designed as shown in the illustration, and when all the adjustment was taken up on one of the engines, I raised the wedge, and as there was a thin shim at A, I thoughtlessly inserted another in the same place. The engine ran only a few hours before one of the wedge bolts broke off at B close to the adjusting wedge. I put in a new bolt, but the engine broke two more bolts at the same place in less than a week. I then decided it was time to use my head a little and reasoned that the shims being inserted at A threw the threaded hole in the wedge out of line with the hole through the strap, causing undue strain on the bolts, which broke them. I took the shims out and put them in at C, and the engine has never broken another bolt.



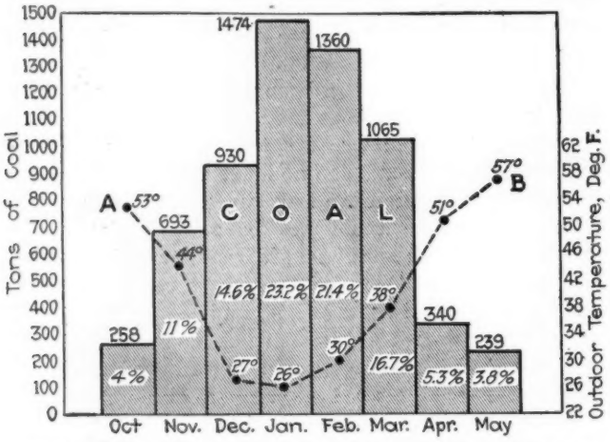
LINERS PUT IN THE WRONG PLACE

Whether the shim should be put at C or at D depends on the travel clearance of the piston. A shim at C will lengthen the rod and reduce the clearance at the head end of the cylinder, while the reverse will be true if the shim is put in at D. W. G. CAMP.

Ash Fork, Ariz.

Coal for Live-Steam Heating Plant

The amount of coal required for heating and the percentage of the total for the season used each month are valuable data in these days of coal shortage and lack of transportation facilities. In this connection the article by M. W. Ehrlich, on "Average and Maximum Heating Demand," in the Mar. 5 issue of POWER is interesting. In many large buildings the power and



COAL USED PER MONTH IN TONS AND PERCENTAGE

heating are combined, and with a scarcity of meters of the proper character it is difficult to separate the coal for the different services. Data from a live-steam heating plant, where coal is burned for heating only, may be of interest. Averages covering the three years, 1915, 1916 and 1917, for the retail department store of Marshall Field & Co. are presented herewith. The data apply to the main building, which is 380 ft. long, 380 ft. wide and 270 ft. high, giving in round numbers an interior volume to be heated of 39,000,000 cu.ft. Illinois washed nut coal averaging 12,000 B.t.u. per lb. is burned.

Extending from October into May the heating season averaged 200 days of 14 hours, or a total of 2800 hours. The average coal consumption was 6359 tons per season. Above the first-floor line the building contains 215,000 sq.ft. of direct radiation, and the cubical content is 32,500,000 cu.ft. This space is 83 per cent. of the total and requires 90 per cent. of the coal, or 11,446,200 lb. Thus the coal consumption per season for that part of the building above ground reduces to 53.2 lb. per sq.ft. of direct radiation. Per 1000 cu.ft. of building space the coal consumption for the season reduces to 352 lb., and this in the writer's opinion is the better ratio to use in comparing the heating requirements of various buildings.

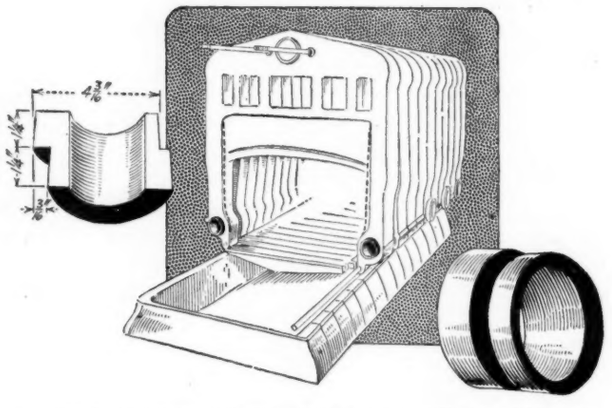
The chart shows the tons of coal used each month, including October and May, and in each case the percentage of the total for the season is given. These figures include the coal required to heat the basements and are given to show the relative quantities of coal required in the different months of the season. The basement has 15,000 sq.ft. of indirect surface, which is usually conceded to be equivalent to about 45,000 sq.ft. of direct radiation. The dotted curve gives the average of outdoor temperature readings taken at 8 a. m. and 4 p. m. every day of the heating season.

Chicago, Ill. C. W. NAYLOR.

Fitting New Sections to a Warped Boiler

In the layout of the heating system of a church in Tarrytown, N. Y., one boiler of nine sections was installed to heat both the parish house, which must be continually heated, and the church, which is heated only on Sundays. The furnace is in the basement of the parish house, and to heat the house and not the church all that is necessary is to have a low fire, not hot enough to force steam over to the church but enough for the house. No valves were provided to shut off the steam from the church. This works fairly well, but there is one trouble; when the church is not heated, there is no way to drain the returns and they remain full of water and are in danger of freezing. In fact one of them did freeze and burst during a cold spell last winter. The sexton built a hot fire under the boiler, got a steam pressure of 15 lb. about 6 p.m. Saturday and then left the church without discovering the burst pipe. He returned at 10:30 that evening and found that all the water had been driven out from the boiler. With the very hot fire and no water in the boiler, the front section was warped out of line one-half inch; resulting in damage amounting to $400. When the new sections arrived, the front section fitted nicely, but the last old section was warped out of line one-half inch; in fact, at least four and probably five sections were warped or spread at the bottom, as shown in the illustration; and being cast iron, it was impossible to force them into place.

Experts were called in, and each one maintained that it would be impossible to fix them so they could be used and that new sections would be necessary at a further cost of $500 to $600. It seemed to me that there must be some way to use these sections, which were still good, having stood a cold-water test of 10 lb. Careful measurements were than made to determine how much



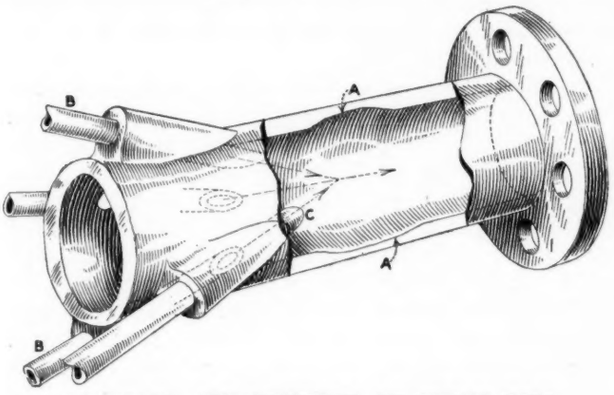
OFFSET NIPPLES COMPENSATE FOR MISALIGNMENT

the nipple holes were out of alignment and it was found that the difference was $\frac{3}{16}$ in. on one side and $\frac{5}{16}$ on the other. Two eccentric, or offset, nipples were made accordingly, with slightly more taper than the regular nipples, and with these the new section of the boiler slipped into place with the same ease as in regular construction. A tight joint was made, and the boiler is giving satisfaction. The saving was nearly $600. As far as I can find out, this is the first time such a repair has been tried out. D. C. ASHMEAD.

Tarrytown, N. Y.

Suggested Steam-Jet Ash-Conveyor Improvements

The operation of steam-jet ash conveyors is simple and so is their construction in the main, but my experience with them indicates that there are one or two parts that might be improved. One is in relation to the method of placing the steam nozzles in the nozzle section. In the system I am using, there are two jets placed diametrically opposite and at an angle of about



PROPOSED ARRANGEMENT OF STEAM JETS

15 to 20 deg. with the axis of the pipe. The streams issuing from these nozzles come together at a point depending upon the size of the pipe and upon the angle of the nozzles.

The indications are that the jets coming together as they do, tend to combine and form a jet similar to that of the gas flame. This shape of jet, together with the ashes, causes a scouring action at the top and bottom of the pipe, as shown in the sketch at *AA*. This pipe is 8 in. diameter, 1 in. thick and 8 ft. long and is of chilled cast iron, which makes frequent renewals expensive. The best way, I believe, is to correct the trouble at the nozzles by placing them so that the resultant discharge is a cone-shaped stream. I believe that this could be done by adding two other nozzles placed as shown at *BB*, or 90 deg. from the present nozzles, which would tend to prevent this action. Care must be taken to have the center line of the nozzles lie in the same plane with the axis of the pipe, or a spiral or centrifugal scouring will be caused. With the coming of warm weather I expect to change the nozzles I am operating, as suggested herein.

The second improvement relates to sharp 90-deg. bends, which, from the point of economy in steam consumption and upkeep, should be replaced with long-radius bends fitted with cast-iron baffle plates. The long bends should be made sectional, as some of them are, so as to be easily replaced.

We have recently installed a skip hoist and tank ash-handling system, and as soon as possible I will forward data giving a comparison of the operation of both systems. Although the jet type of conveyor uses a greater amount of steam during the time it is engaged in removing ashes, the steam is used but a short time at each ash removal, and the system has the advantage of being capable of taking care of a great overload, which cannot be said of the skip hoist unless it is of very liberal size. H. G. BURRILL.

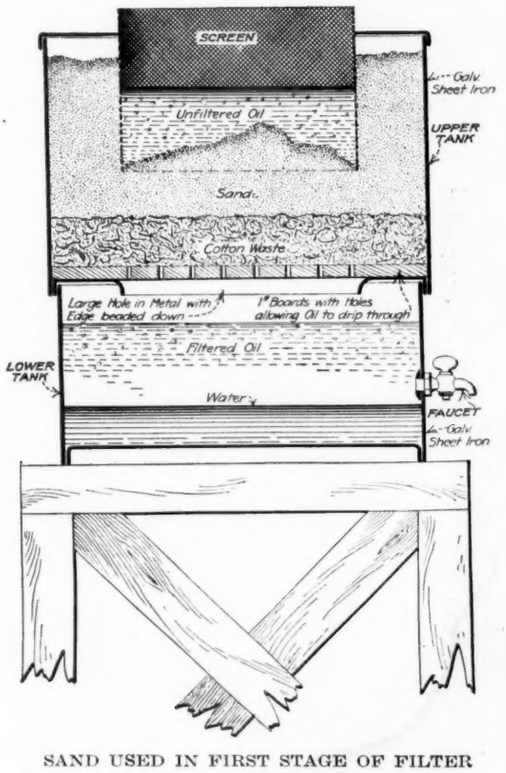
Herkimer, N. Y.

Sand Filter for Used Oil

Perhaps other power-plant engineers have experienced difficulty in filtering lubricating oils which have become heavily laden with grit and other foreign substance. The illustration shows a primary filter, which I constructed, to take care of black and badly carbonized lubricating oil drawn from the well of a semi-Diesel fuel-oil engine, which has proved entirely satisfactory for the purpose. I found that, quite contrary to the prevailing opinion, oil can be filtered through sand without danger of injury to the most delicate bearings in which it may be used later. After the oil is drawn from this filter it is, as an extra precaution, put through a standard make of oil filter.

The upper tank can be removed from the lower tank or reservoir for cleaning. The water in the lower tank is not necessary, but since a space for settling is left below the faucet, the use of water obviates the necessity for the excessive amount of oil which would otherwise be required to bring it to the faucet level. The construction of the upper tank is such that it will fit nicely on the lower tank and prevent the oil from creeping to the outer edges by the bottom having a large hole cut in the center and its edges beaded down, as shown.

The plan of screen arrangement allows for the adjustment of the amount of sand through which the oil must pass before reaching the waste, and by bringing the sand up around the sides of the screen, the oil



SAND USED IN FIRST STAGE OF FILTER

is prevented from seeping down between the side of the tank and the sand unfiltered.

I will appreciate comments in the columns of *Power* and suggestions for improvements and also to know whether any engineer has previously used such a filter.

Harvard, Neb. JULIUS E. PERSON.

Supporting Effect of Boiler Heads

I was much interested in the article by Neil M. Macdonald in *Power* of May 21, wherein it is shown that the strength of the unsupported head should not be added to the strength of the stays to find the allowable pressure in a boiler. However, I question Mr. Macdonald's line of reasoning.

Let us confine our argument to the very good illustration of the two walls joined by a rope. The author states that "when the pressure reaches 528 lb., which is the ultimate strength of the rope, the rope breaks." This is not so, for the weaker wall is able to withstand 296 lb., so that there is a pull on the rope of only 232 lb., and the rope will not break. The author admits that "the pressure rises slowly until 296 lb. is reached . . . but there is no perceptible change in conditions, as both walls still stand and the rope is still intact." In other words, the rope is not subjected to any stress as long as the pressure on the wall is less than 296 lb., so that when the pressure on the wall is greater than 296 lb., the pull on the rope is equal to the amount that the pressure exceeds 296 lb. The pull on the rope will equal 528 lb. only when the pressure on the wall has reached 824 lb. Hence, the strength of the unsupported head should be added to the strength of the stays to obtain the allowable pressure in a boiler.

Bridgeport, Conn. D. FLIEGELMAN.

A hasty first perusal of the article in the May 21 issue of *Power*, page 733, caused the writer to wonder if the author of that article was serious in his views or merely wanted to start something. If Mr. Macdonald's argument is a valid one, then in every line of machine design much material has been added uselessly in order to give supposedly greater strength to some weak member.

It seems strange that he did not go a step farther and assume that sixteen braces supported the head. He should have assumed that the total load to be carried by these sixteen stays was 80,000 lb. so that each stay would singly support 5000 lb. Then, using his "wall" argument, when the load rose to 5500 lb. one stay would break, since this was beyond its capacity; then the second, third, etc., would successively break under this load.

The conclusion to be drawn would follow the conclusion he stated—the strength of the boiler or stone wall was the strength of its strongest part, namely, one stay or brace. Absurd, you will promptly decide. No more than Mr. Macdonald's conclusion. Why does he not state the actual conditions existing in his wall? If he loads it with 528 lb., it can be assumed either that the rope bears all the pressure or that it is divided between the wall and the rope. Now, the wall has a resistance of 296 lb., then surely 296 lb. can be added before the combined resistance is overcome.

Philadelphia, Penn. E. S. MORRISON.

The article in the May 21 issue of *Power*, page 733, seems correct to me in its final conclusion, namely, that a boiler head should be stayed without taking into account the strength of the unstayed head. But is the author not mistaken in his explanation of the reason why? It looks to me that with his weaker and stronger wall with a rope between, the strength of the weaker wall can safely be added to the strength of the rope to find the pressure at which the rope will break and the wall topple over, for both are rigid and both give their ultimate strength in the same position and at the same time. But with the boiler head it is not the same, for while the head might be ultimately strong enough to withstand considerable pressure, the pressure it will stand and remain in position is very much less; therefore, the stays must take the whole pressure, for the position the head will take under little pressure is beyond the position where stays will be broken off.

To illustrate, take a spiral spring with an eye-bolt in each end, hook up one end and hang a weight on the other end. Suppose that the spring will sustain a weight of 1000 lb. Now take the weight off, put a solid bolt from eye-bolt to eye-bolt through the center of the spring, make it just the right length so that the spring will be in its normal unstrained position, and make the bolt of sufficient strength to support 2000 lb. It is possible that some might think that the combined bolt and spring would suspend 3000 lb., and they would but for the fact that the bolt will be broken before the spring begins to take any material part of the load.

A wall and a tight rope, two bolts or any other combination of materials that will take strain at the same time, up to their ultimate strength, will have the resistance of one plus the other. With the spring and bolt, or the stayed boiler head, the strain it will stand is the strength of the first to fetch up, plus whatever strain is on the other element in the position where the first member takes up, and no more. With the boiler so little pressure will cause the flat head to move away from the pressure, that in figuring the strength of stays to keep the head in place the effect of the head should not be reckoned and is not in practice, usually. L. JOHNSON.

Exeter, N. H.

Wood for Pipe Covering Dangerous

On page 742 in the issue of May 21 there is a description of a system of pipe covering, which is not new, and is not desirable, as it is dangerous. Back in the early 80's I was in charge of a plant in the Middle West, in which the steam piping was covered in a similar manner and I think it had been patented. Having to make some changes in the piping to the cylinder lubricator, which was connected into the steam pipe just above the throttle valve, I had to remove some of the pipe covering and found almost all of the wood converted to charcoal, so soft that it could be easily crushed to powder with the fingers, and a spark would have started a blaze. The old covering was therefore ripped off, and a covering more nearly fireproof substituted.

In "ye olden times" it was the custom also to lag engine cylinders with fancy wood, but wherever this lagging was in contact with the bare metal it would invariably char, and steam pressures were low then compared with present practice, one hundred pounds being considered high. ALONZO G. COLLINS.

Philadelphia, Penn.

Inquiries of General Interest

Over-All Efficiency of Pumping Plant—What would be the over-all efficiency, or ratio of water horsepower to electric input, of an electrically driven pumping plant, where the efficiency of the motor is 85 per cent., efficiency of pump 70 per cent. and efficiency of pipe lines 75 per cent.?

J. H. N.

The over-all, or combined, efficiency would be the product of the separate efficiencies: namely, $0.85 \times 0.70 \times 0.75 = 0.44625$, or practically 45 per cent.

Height of Barometric Condenser—Would there be any gain in vacuum by raising a barometric condenser from 34 ft. to 38 or 40 ft. above the water in the hotwell? L. B. R.

The purpose of having an elevated discharge pipe is to obtain a column of water that will produce sufficient pressure for the water to discharge itself against the pressure of the atmosphere acting on the water of the hotwell. Under ordinary conditions, 34 ft. is sufficient for the purpose, and additional height would be of no advantage.

I.Hp. for Increase of R.P.M. and M.E.P.—An engine running at 75 r.p.m. with 40 lb. m.e.p. develops 100 i.hp. If the speed is increased to 80 r.p.m., what number of horsepower would be developed with 45 lb. m.e.p.? J. J. H.

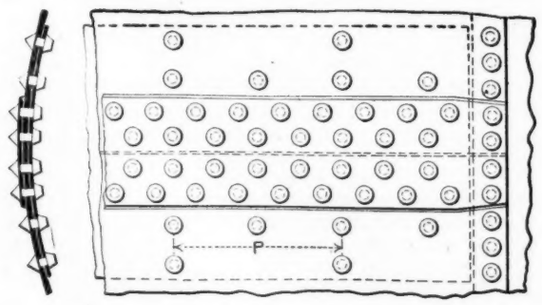
The power developed would be directly in proportion to the speed and the mean effective pressure. Therefore with 80 r.p.m. and 45 lb. m.e.p. the engine would develop

$$100 \times \frac{80}{75} \times \frac{45}{40} = 120 \text{ i.hp.}$$

Break in Boiler-Feed Line from Stoppage of Pump—My foreman states that stopping of the feed pump was the cause for frequent breaking of a tee in the feed line. How could that occur? M. S. C.

Stoppage of the pump might be an indirect cause of the breakage from expansion of the feed line, as a result of the feed line becoming heated from leakage of a boiler check valve; but breakage of the line from overheating should not happen if the feed line is laid out with proper allowances for expansion and contraction.

Efficiency of Quadruple-Riveted Boiler Joint—What is the efficiency of a quadruple-riveted butt and double-strap boiler joint like the sketch, made of steel plates of 55,000 T.S. and 95,000 lb. crushing strength, and having main plates ½ in. thick; butt straps $\frac{7}{16}$ in. thick; P, the pitch of



rivets in the outer row, 14 in.; diameter of rivets after driving, $\frac{15}{16}$ in.; shearing strength of rivets in single shear, 44,000 lb., and in double shear 88,000 lb. per square inch?

I. T.

The diameter of the rivet holes and rivets after driving would be $\frac{15}{16} = 0.9375$ in., and each rivet would have a cross-sectional area of $0.9375 \times 0.9375 \times 0.7854 = 0.6903$ sq.in. For each unit length of joint $= P$, there would be three rivets in single shear and eight rivets in double shear and for such unit of length there would be,

(A) Strength of solid plate,

$$14 \times 0.5 \times 55{,}000 = 385{,}000 \text{ } lb.$$

The strength of the joint per unit P of length would depend on one of the following considerations:

(B) Strength of plate between rivet holes in the outer row,

$$(14 - 0.9375)\ 0.5 \times 55{,}000 = 359{,}219 \text{ } lb.$$

(C) Shearing strength of eight rivets in double shear, plus the shearing strength of three rivets in single shear,

$$(8 \times 88{,}000 \times 0.6903) + (3 \times 44{,}000 \times 0.6903) = 577{,}091 \text{ } lb.$$

(D) Strength of plate between rivet holes in the second row, plus the shearing strength of one rivet in single shear in the outer row,

$$[[14 - (2 \times 0.9375)]\ 0.5 \times 55{,}000] + (1 \times 44{,}000 \times 0.6903) = 363{,}811 \text{ } lb.$$

(E) Strength of plate between rivet holes in the third row, plus the shearing strength in single shear of two rivets in the second row and of one rivet in the outer row,

$$[[14 - (4 \times 0.9375)]\ 0.5 \times 55{,}000] + (3 \times 44{,}000 \times 0.6903) = 372{,}995 \text{ } lb.$$

(F) Strength of plate between rivet holes in the second row, plus the crushing strength of butt strap in front of one rivet in the outer row,

$$[[14 - (2 \times 0.9375)]\ 0.5 \times 55{,}000] + (0.9375 \times 0.4375 \times 95{,}000) = 372{,}402 \text{ } lb.$$

(G) Strength of plate between rivet holes in the third row, plus the crushing strength of butt strap in front of two rivets in the second row and one rivet in the outer row,

$$[[14 - (4 \times 0.9375)]\ 0.5 \times 55{,}000] + (3 \times 0.9375 \times 0.4375 \times 95{,}000) = 398{,}770 \text{ } lb.$$

(H) Crushing strength of plate in front of eight rivets, plus the crushing strength of butt strap in front of three rivets,

$$(8 \times 0.9375 \times 0.5 \times 95{,}000) + (3 \times 0.9375 \times 0.4375 \times 95{,}000) = 473{,}145 \text{ } lb.$$

(I) Crushing strength of plate in front of eight rivets, plus the shearing strength, in single shear, of two rivets in the second row and one rivet in the outer row,

$$(8 \times 0.9375 \times 0.5 \times 95{,}000) + (3 \times 44{,}000 \times 0.6903) = 447{,}370 \text{ } lb.$$

There would be least strength of the joint from consideration (B) and the efficiency of the joint would be

$$\frac{(B)}{(A)} = \frac{359{,}219}{385{,}000} = 93.3 \text{ } per\ cent.$$

Power Absorbed by Idler Pulley—How much power is lost from the use of a 28-in. diameter idler pulley on a 2½-in. shaft making 220 r.p.m., used to hold a quarter-turn of a 17-in. double leather belt? A. T. M.

The power lost by use of the idler consists mainly of the bearing friction that results from pressure resulting from the direction and tension of the belt and the weight of the belt, pulley and shaft. The maximum belt tension probably would not exceed 90 lb. per inch of belt width, or about $17 \times 90 = 1530$ lb., and having a belt angle of 90 deg. the resulting pressure from belt tension would be $1530 \times 1.4 = 2142$ lb. The horsepower absorbed by friction of shafting, with continuously oiled bearings, is approximately equal to

Total pressure in bearings in pounds × *diameter of bearings in inches* × *r.p.m.* ÷ 2,900,000.

Allowing the total pressure on the bearings from belt tension and weight of belt, pulley and shaft to be 2500 lb., the power lost by friction would be 2500 lb. × 2.5 in. diameter × 220 r.p.m. ÷ 2,900,000 = 0.47 or about one-half horsepower.

[Correspondents sending in inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

Meeting of National Electric Light Association at Atlantic City

THE thirty-fourth annual meeting of the National Electric Light Association was held in the Hotel Traymore, Atlantic City, N. J., June 13 and 14. In the words of W. W. Freeman, past president of the association, it was "The most serious and the most inspiring convention the association ever held." The attendance was comparatively small, only a little over 300 being registered, owing to many being away on and too busy to leave war work.

The following were the chief features of the address of President John W. Lieb, general manager and vice president, New York Edison Co.:

Address of Mr. Lieb

Mr. Lieb pleaded for continuation of teamplay in the electrical industries, in which he included street railways, telephone, telegraph, light, power and the manufacturing enterprises. Mr. Lieb said there were about 920,000 men engaged in the industry which represents capital of about $10,750,000,000 and an output valued at $2,675,000,000 a year. The electric light and power industry employs about 125,000 men, the capital invested is $3,000,000,000, and the annual business done amounts to $575,000,000.

The industry, according to Mr. Lieb, is second only to the great national railway system. He regards "linking up" of systems first to further fuel economy as the most important problem now confronting the industry. The public utilities were urged to take the initiative in this and similar matters; otherwise, he said, Government control would follow.

The mounting costs of conducting business have left nothing for dividends and sometimes have not covered fixed charges, and in any case have left barely enough to cover operating expenses.

The coal shortage, Mr. Lieb claimed, was due to labor shortage at the mines, transportation breakdown, troubles at the tidewater terminals and to lack of coal cars. Experience in normal times has shown it unsafe to begin the winter with less than 30 to 45 days' coal supply; now one cannot hope to accumulate the 60- to 90-day supply that the uncertainties of the present make necessary. Fuel costs from 75 to 80 per cent. of the cost of current delivered to the switchboard and from 20 to 25 per cent. of the cost delivered to the customer. Further fuel economy is impracticable at this time, although advantage may be taken of the diversity factor between systems, operating with a common reserve, and of the assistance which one system may give another through interconnection.

It does not need demonstration to prove that the coal consumption in the isolated plant is generally from 2½ to 4 and 5 times the amount required to produce the same quantity of electrical energy in central stations. Parallel operation of street systems (central station) and isolated plant is hardly practicable, in Mr. Lieb's opinion.

He recommended keeping the clock advanced one hour the year round. Relative to the growing shortage of labor, he pleaded for exemption from military service of those specially trained unless, of course, they were going to use their special training in the service. The further employment of women is now a live problem, and one soon to demand attention is the training and employment of the wounded and blind returned soldiers.

The member companies have purchased to date $29,555,250 in Liberty Bonds and $1,467,945.69 in War Stamps.

Mr. Insull's Address

The next address of importance to the industry broadly was made at the dinner, Thursday evening, by Samuel Insull, president, Commonwealth Edison Co., Chicago, Mr. Insull sounded the trumpet of hope and confidence in the industry. He said that relief from the burdens of high cost of conducting the industry could be had if the reasons for rate increases were properly put before the people in the various localities where rate increases were necessary. He based his belief upon the fact that in 1917 out of 467 applications for rate increases 400 decisions in favor of such increases were given by the public-utility commissions hearing the cases. With labor increasing its wage, cost of fuel increasing as part of Governmental action, and with supply and demand exerting their usual force, it does not seem possible that the industry can contemplate the selling price remaining stationary. Those conducting the industry must have confidence in their industry if investment bankers were to be expected to invest their money in it. The industry must conduct itself so as to get and to maintain the confidence of the constituted authorities and so pass this confidence on to investment bankers.

Relative to fuel orders Mr. Insull said that every order of Mr. Garfield reduced the central-station load factor and reduced returns. As to the "lightless night" order, cutting out all electrical display advertising, it effected the industry's earning capacity out of all proportion to the coal saved. But because of its awakening effect upon the people, Mr. Insull said he would have done as Garfield did.

The speaker urged that central stations drop extravaganees of a capital character and of operating nature. This is not the time to consider balance sheets.

To make up for the shortage of coal cars all unnecessary forms of improvements must be postponed and the open-top car equipment used to transport the materials for such improvements used for hauling coal. There is not the time or the capacity to make all the new equipment needed; it must be taken from other channels not absolutely necessary.

Address of Mr. Noyes

P. B. Noyes, Director Conservation Division of the United States Fuel Administration pointed out the enormous physical proportion of the work the administration was doing. The cotton crop of a whole year could be moved in one day of coal movement, and thirty days of coal movement are equivalent to the movement of the coming second largest wheat crop. Eighty millions more tons of coal will be needed by the industries alone this year over last. America must mine 220 million tons in excess of that ever before mined in one year. "We need 100,000,000 tons more coal this year than last; if we mine half of it we will do well," said Mr. Noyes. The draft had taken away 35,000 coal miners.

Mr. Noyes says that classifying industries as essential and non-essential cannot be done; he divides them as war and nonwar. He pointed out that it was impracticable to cut off completely fuel to nonwar industries even when some war industries must go without it, because industrial dislocation, riots, strikes and great evils would follow if coal was unthinkingly withheld from many centers where there were few except nonwar industries. These industries, said Mr. Noyes, use less than 100 million tons of coal a year. One ton of coal meant keeping at least fifty people at work. That is one view he wishes persons to take of the coal situation.

We, the administration, must tell the public utilities as we told the steel people, namely: make the utility business 100 per cent., then you will get 100 per cent. coal, said Mr. Noyes. The utilities must refuse service to those whose use of it is not more or less intimately associated with the winning of the war, and they must see to it that those using the service use it economically. The administration expects the utilities to do much of their own policing in respect to this field of conservation.

Doctor Wheeler's Address

Dr. S. S. Wheeler made an illuminating address on training the blind to do work in the electrical industry. They are now successfully winding coils of stators and armatures at the same piecework rate paid sighted persons. Arthur Williams also spoke at the dinner; his subject was food conservation.

The Prime Movers Committee was represented only by N. A. Carle, all other members being absent. Mr. Carle is the new appointee to the committee, having taken the place of the late John P. Sparrow, of the New York Edison Co.

George A. Orrok gave a paper on "Location of Power Plants at the Coal Mines," and Philip Torchio, electrical engineer, New York Edison Co., had a paper on "The Utilization of Water Power as a Measure of Coal Conservation." The chief point of Mr. Torchio's remarks was that the East must depend upon steam for the great heat unit requirement of this section, as adequate water power is unavailable.

Charles E. Stuart, chief of power and light division, United States Fuel Administration, read a paper on "War Conservation of Power and Light," from which the following is taken:

General plans have been laid out for the conservation of light and power by the Bureau of Conservation of the United States Fuel Administration, of which P. B. Noyes is director, and these plans will be carried out by the Power and Light Division. They will be developed under the following subdivisions: (1) Elimination of Uneconomical Isolated Plants. (2) The Application of the Skip-Stop to Railways and the Regulation of Car Heating and Lighting. (3) Economy in Utilization of Power and Light in Factories. (4) Utilization of Excess Water Power and Interconnection of Power Systems. (5) Limiting the Production of Power to the Most Efficient Points Available. (6) Economy in the Refrigerating and Ice-Manufacturing Industry.

A brief statement with respect to each of these subdivisions is developed below.

The plans will be carried out through the coöperation of the following: *First*, a force of engineers organized and stationed with the Fuel Administration at Washington; *second*, the Engineering Department of the United States Geological Survey; *third*, the Power Division of the Council of National Defense; *fourth*, a state fuel engineer attached to the office of the State Fuel Administrator, to supervise the activities in his state; *fifth*, the public service commissions and state regulatory bodies; *sixth*, the chambers of commerce and similar representative business bodies; *seventh*, volunteer engineers located throughout the country.

The following gives the scope of the subdivisions:

1. Elimination of Uneconomical Isolated Plants

The individualistic way in which fuel is now consumed in cities is not efficient. A ton of coal burned in a large central station will produce at least four times as much electric power as if burned in the average small plant, and if centralized burning could be introduced to a greater extent, the amount of fuel required could be largely reduced without reducing in any way the ultimate production of light and power.

It is frequently the case that in buildings where electric plants are located and where exhaust steam is utilized in the heating of the building and in furnishing hot-water requirements, such buildings can adopt central-station service without a loss of money and at a saving in fuel.

As a rule it may be stated that where no extensive heating system is operated in conjunction with the generating plant, such a plant can purchase power at a great fuel saving and with a possible reduction in power cost. In other cases it would be more economical, from the viewpoint of fuel saving, to utilize central-station service in conjunction with isolated electric plants.

It is the duty of the Fuel Administration to devise means for securing a curtailment in the use of fuel in ways that will impose a minimum of hardship. It is believed that there are many plants, not only in New York but throughout the entire country, which could, at least temporarily, shut down their own electrical machinery and purchase power from others at a financial advantage to both parties and with a considerable saving in fuel.

The Fuel Administration believes that if even a comparatively small proportion of the plants throughout the country which could save fuel in this way at a profit to themselves would do so, it would prove a tremendous help in meeting the fuel situation with which the country is confronted, and in winning the war.

While it may appear that the interests of the central station are being benefited to a large degree, such is not of necessity the case. In some cases, central stations may be shut down. In any event any connection between a central station and a building or a manufacturing plant that is affected, will, of necessity, be for the period of the war only or through the period where the coal situation is critical. The machinery of the isolated plant can be readily preserved through this period of necessity. Under these circumstances the heavy expense attendant upon the making of the connection by the central station may completely or even more than offset any profit which could be expected of such a load through a short period.

2. Economy in Utilization of Power and Light in Factories

The United States Fuel Administration is requesting, as a means of accomplishing power and light conservation in manufacturing and industrial establishments, the appointment, by the management, of a Shop Committee, composed of those best suited for the purpose and in size or number suitable to the size of the plant, one member of this committee to act as its chairman; the committee to be active with and have charge of all details in the operation of the plant that would in any way contribute to economy in fuel or that in which fuel is used to produce, and report weekly to the management or head of the plant.

It is also suggested that this committee be changed from time to time, so that the spirit and interest in this work may be maintained.

It is not the purpose arbitrarily to outline in detail the method for doing this work, rather to suggest in a general way, leaving the details and adoption of the plan in the hands of the manufacturers interested, as we realize that conditions in different plants and character of manufacture, as well as organization, will have a bearing on the size, character and details of the committee, which must be suited to the particular case under consideration.

As a typical illustration of possible waste and opportunity for conservation, we suggest the following items: (1) Lights being unnecessarily burned; (2) lamps of too high candlepower; (3) the elimination of carbon lamps in favor of Mazda lamps where practicable; (4) the elimination of arc lamps and substitution of nitrogen-filled lamps, which are from two to three times as efficient; (5) the restricted use of sunlight due to dirty windows; (6) operation of motors when machinery is idle; (7) excessive sparking, heating or erratic speed of motors; (8) improper alignment of shafting; (9) grouping of machines so as to operate motors or engines as nearly loaded as possible; (10) staggering of operations so as to maintain as flat a load curve as possible; (11) slipping belts; (12) dry bearings; (13) overheated or underheated parts of plant; (14) excessive drafts due to lack of proper protection about openings of doors, windows, elevator and staircase areas; (15) the reduction of elevator service or the application of a skip-stop to elevator service; (16) the testing out of power circuits for relationship of capacity to load carried; (17) the paralleling of power circuits.

We also suggest that the work of this committee be conducted in such a manner as to provide records of savings, which could be incorporated in reports and information desired from time to time as to the progress of this work.

3. Utilization of Excess Water Power and Interconnection of Power Systems

A method of fuel conservation that promises a certain amount of immediate relief and at the same time opens up a field with almost limitless possibilities for future development is the interconnection of the present power systems of the country, and the consequent utilization of considerable excess water power which is at present available.

In many parts of the country duplicate transmission systems exist, serving practically the same territory. An interconnection between these systems for the mutual exchange of energy would, in many cases, result in marked economies. In other cases, the lines of a power company which derives all, or nearly all, its energy from water power may extend very close to the lines of another company which uses coal to a large extent for the generating of power. Since no company is so fortunate as to be operating with a 100 per cent. load factor, there are necessarily times during light load when the water-power company is forced to allow unproductive water to flow over its dam. At such a time a great saving in fuel would be effected were the two companies tied together and the load on the steam station transferred in part or entirely to the water-power plant. Numerous hydro-electric companies have for a long time been carrying out this idea within their own systems, where the bulk of their power is derived from water, and at the same time they maintain a steam reserve to carry their load during low-water periods.

In some cases these system interconnections would involve a considerable expenditure of both time and money, in which

event they would not be subject to immediate aggressive action by the administration but would be held in abeyance as possibilities for future consideration and developments.

4. Limiting the Production of Power to the Most Efficient Plants Available

We have been able to locate nearly 500 instances throughout the country where there exists, in one form or another, a duplication of power production and supply. In other words, there are communities where two or more central stations are furnishing electrical energy with systems paralleling one another.

In certain instances the results of such a condition are not serious and in many cases probably unavoidable. Our investigations so far, however, have proved that a large percentage of these situations offer an opportunity for large fuel conservation.

5. Economy in the Refrigerating and Ice-Manufacturing Industry

In coöperation with the Joint Commission on Refrigeration, which was organized to assist the Government during the war, the Power and Light Division is planning to get in touch with the entire ice industry to introduce a number of proved economies in the operation of ice-and-refrigerating plants.

A number of suggestions have already been made by the commission and by individuals connected with the industry. One plan that possesses merit and has possibilities of considerable fuel saving is that of allotting a definite amount of coal to individual plants, depending upon the size and type of plant, such allowances being based upon a reduction of 10 to 15 per cent. of the average present fuel consumption. This will make it necessary to adopt many simple measures of economy that are now being overlooked.

Another possibility is that of producing white or opaque ice at a fuel saving of 5 to 20 per cent. This is accomplished by eliminating the power that is generally used for agitation in raw-water plants and for producing distillate in distilled-water plants, both of which are merely means of producing a transparent product. This measure is possible of adoption in many territories.

A further line of effort which will be productive of considerable economy and one that was successfully applied last winter is that of operating during the winter season only the most efficient plant, or plants, as the particular case requires, in communities where, during the summer season, all plants are required. This can be done and the individual business of each manufacturer will not be interfered with, as the arrangement provides that the operating plant or plants will sell at wholesale rates to those manufacturers whose plants are temporarily closed down.

This arrangement also produces a saving in ammonia, and for this reason was applied last winter at the request of the Food Administration.

W. W. Nichols, of Allis-Chalmers Co., gave the following in his paper on "The Development of Water Power as a War Measure":

The year 1917 was one of inferior demand in water-power machinery, yet 1,058,000 hp. of hydro-electric machinery was built and installed. This alone represents a saving of 8,500,000 tons of coal, besides a saving in production labor and transportation. Ten per cent. of the estimated coal shortage of this year therefore would be met if the industry could do as well this year. Without building new plants there are two ways of hydro-electric development: (1) By increasing the capacity of plants already built. In this connection it has been estimated that 300,000 hp. can be developed in the next twelve months by central stations. (2) Replacement of machinery installed prior to 1911. This would take care of an increased horsepower of 450,000. By these means 6,000,000 tons of coal would be saved in the twelve months in addition to labor and transportation. Power is now more than ever fundamental to our existence. The power shortage is a national calamity, calling for a broad national treatment.

The convention visited the shipyards at Hog Island Saturday.

W. F. Wells, vice president and general manager of the Edison Electric Illuminating Co., Brooklyn, N. Y., was elected president of the association.

New York State Convention, N. A. S. E.

The New York State Association of the N. A. S. E. held its twenty-third annual convention at Coney Island, June 13-15. The Shelburne Hotel on the boulevard at Ocean Parkway was the headquarters. There were fully seventy-five delegates present. The business sessions of the convention were held in the balcony on the second floor of the hotel. The front portion of the main dining room was artistically decorated and conveniently arranged for the mechanical display. From the exhibitors' standpoint the arrangements for their convenience and comfort outclassed anything in the history of the state association. There were 52 companies represented. The meetings of the delegates were unusually interesting this year, and much important business was dispatched in the three days.

The opening ceremonies of the convention took place on Thurday evening. John B. McGowan, chairman of the local committee, delivered a brief though earnest address on the needed efficiency of the members of the N. A. S. E. in the present crisis. He then introduced Judge Henry Goldfogle,

SOME OF THOSE IN ATTENDANCE AT THE NEW YORK STATE N. A. S. E. MEETING

who welcomed the delegates to the city, congratulated them on the preamble of the organization, and told them of the responsibility which now rests upon the engineer. George Van Vechten responded for the delegates, and Fred Felderman spoke of the necessity of closer attention to the educational work of the members of the N. A. S. E. The meeting was then adjourned until Friday morning at 8 o'clock.

On Friday morning the ladies were taken on an automobile sightseeing trip, and in the afternoon enjoyed a vaudeville show at Henderson's theater.

One of the features of the convention was the banquet on Friday evening, attended by the delegates, supplymen and ladies; covers were laid for two hundred. During the dinner Monroe Silver, Billy Murray, Bob Jones and Jack Armour entertained.

At the final meeting on Saturday evening the delegates elected the following state officers: P. H. Cassidy, Brooklyn, president; Robert Tobin, Troy, vice president; William Roberts, Yonkers, secretary; William Downs, New York, treasurer; W. B. Wear, Middletown, conductor; F. J. Desmond, Rochester, doorkeeper; A. T. Bennett, Brooklyn, chaplain; Samuel Thackerberry, New York, state deputy.

Next place of meeting Troy, N. Y., in June, 1919.

The retiring state president, George C. Van Vechten, was the recipient of a mahogany clock, and Mrs. Van Vechten received a dressing-table set of cut glass.

The memorial services were conducted by the Rev. Arthur H. Cummings.

Annual Convention of American Boiler Manufacturers' Association

The American Boiler Manufacturers' Association held its thirtieth annual convention at the Bellevue-Stratford Hotel, Philadelphia, on June 17 and 18. At the opening session on Monday morning, the president of the association, M. H. Broderick, addressed the convention. He was followed by Dr. E. J. Cattell, city statistician of Philadelphia, who welcomed the association to the city. D. M. Medcalf, chief inspector of steam boilers, of Toronto, was called upon to speak and told of the part that Canada was playing in the furtherance of war work. William H. Barr, president of the National Founders' Association, next addressed the delegates, after which Dr. D. S. Jacobus, of the Babcock & Wilcox Co., gave a talk on furnace and combustion chamber volumes, illustrated by blackboard sketches. *Power* hopes to present the main points of Dr. Jacobus' talk in a later issue.

At Monday afternoon's session, E. R. Fish presented the financial report of the committee on uniform boiler laws. The work accomplished by this committee during the past year was outlined by Charles E. Gorton, who said that since the 1917 convention seven states had adopted the A. S. M. E. Code. In Kentucky active support had been obtained and a campaign was being organized to submit a bill to the state legislature. In Louisiana legislation had been introduced, calling on the governor to appoint a committee to investigate the desirability of adopting the A. S. M. E. Code and to report its findings to him. The Merchants' and Manufacturers' Association of Baltimore had been interested in the matter and a bill will be introduced at the next session of the Maryland legislature. The governor of Missouri has recognized the importance of adopting a uniform boiler law and favorable action is expected on the bill that is to be introduced in that state. In South Carolina the work moves slowly, but in due time the state may take up the matter. In Virginia it is expected that the bill will be reported out of committee at the next meeting of the legislature. Montana appreciates the need of such a law, and is in a favorable position to act on it, as the Industrial Accident Board is able to put the law into effect. Iowa is in the same state of mind and the legislature is expected to act favorably. Progress is being made in Massachusetts, but in Rhode Island the bill was not reported out of committee. In Vermont and New Hampshire the prospects are good. In Georgia the Manufacturers' Association is pledged to further the interests of a bill to adopt the A. S. M. E. Code.

C. O. Meyer, deputy inspector of the State of Ohio, presented a communication from his department, pointing out that the A. S. M. E. Code fails to cover vertical-flue boilers and track locomotive boilers, and that as a consequence it had been necessary to ignore the A. S. M. E. Code and use the rules of the Interstate Commerce Commission. He intimated that Ohio might return to its own rules, in force before the adoption of the A. S. M. E. Code, and suggested that the chairman of the American Uniform Boiler Law Society be a man who is neither a member of the A. S. M. E. Code Committee nor a boiler manufacturer.

A letter from the United States Board of Supervising Inspectors pointed out that their own inspection rules had been in use for sixty years, had met all conditions, were efficient and safe, and for those reasons the board declined to adopt the A. S. M. E. Code instead.

The vice president of the association, C. V. Kellogg, gave an exceedingly earnest and stirring address. He pointed out the folly of individualism and the necessity of organization and coöperation among boiler manufacturers to meet the industrial conditions that would follow the war, particularly the labor crisis that was sure to arise. C. J. Champion, who followed him, also took coöperation as the theme of his remarks, and described how it could be obtained and the results it would produce.

Col. F. N. Gunby, U. S. A., gave a very interesting account of the methods employed in building the various cantonments and the difficulties to be overcome. His talk was illustrated by lantern slides and moving pictures showing construction work in progress and in various stages of completion.

On Tuesday morning, G. S. Barnum presented the report of the committee on uniform costs. He outlined a simple cost-keeping system, laying particular stress on the method of distributing overhead charges. Charles A. Howard, who spoke next, disagreed with Mr. Kellogg on some points. He insisted that a cost system had other uses besides showing how much profit to charge. At the close of his speech, the president announced that Charles M. Schwab, director general of the Emergency Fleet Corporation, had just arrived and would address the convention. As Mr. Schwab entered the convention hall, he was given an enthusiastic welcome by the delegates. In responding to this ovation, he impressed upon the boiler manufacturers the important part they must take in the success of the shipbuilding program, inasmuch as the lack of accessories is the greatest cause of delay. From 80 to 90 per cent. of the hulls now afloat are waiting for engines, boilers or other accessories. Mr. Schwab said that beginning with July 1 he expected to publish a list of the relative performances of all the shipyards in the United States, showing those which had done the best as well as those which had fallen short of expectations, so that the American people should know exactly where to place praise or censure. Further, he said he intended to ask Congress to authorize service medals, to be awarded for industrial work to those concerns that have done and are doing their best to aid in winning the war. By this means he hopes to give public recognition of the services of those who deserve it because of their efforts and achievements in the industrial promotion of war tasks.

At Tuesday afternoon's session, Hon. Edwin F. Sweet, Assistant Secretary of Commerce, addressed the delegates on the subject, "Some Compensations of the War." He showed that as a nation we will benefit from the war by becoming more economical; that we shall increase production both in industry and in agriculture; that we shall learn the forgotten trade of shipbuilding and develop a vast merchant marine to serve a great foreign trade; that we shall learn how to guard against the ravages of preventable diseases; that our inventive genius will be spurred to greater achievements; and that both individual and national character will receive a wonderful uplift.

W. C. Connelly, chairman of the committee on war service, reported as to the work accomplished by that committee. It had sent out questionnaires to boiler manufacturers throughout the country and had received responses from

95 per cent. From the information thus obtained, the equipment and manufacturing facilities of practically every boilermaking establishment had been listed. This information was sent to all the various Government departments to which it could be of service.

The nominating committee presented the list of nominees for officers of the association, as follows: President, W. C. Connelly; vice president, C. V. Kellogg; secretary-treasurer, H. N. Covell; executive committee, M. H. Broderick, G. S. Barnum, W. J. Moore, E. C. Fisher and Dr. D. S. Jacobus. They were unanimously elected. The place of the next convention was left to the decision of the executive committee.

N. A. S. E. Iowa State Convention

On June 12-14 at Cedar Rapids the Iowa State Association of the National Association of Stationary Engineers held its fifteenth annual convention. It was an unqualified success notwithstanding the busy times and war conditions. Over one hundred engineers were registered and with the Ladies' Auxiliary and the exhibitors the attendance was exceptionally good. The exhibits were up to standard and the program made up by the convention committee was carried through with enthusiasm. Headquarters was at the City Auditorium, where the sessions were held and the exhibits displayed.

With F. W. Laas, state president, in the chair, the convention opened Wednesday afternoon. Mayor J. F. Rall gave the address of welcome. He was pleased to notice that the organization stood for education. It was a rare exception in these days to find an institution that was not organized for raising salary. The mayor spoke of the Cedar Rapids adjustment plan which called for arbitration in any dispute between capital and labor. It was his hope that the visiting engineers would find many things of interest in the city.

F. W. Raven, national secretary, responded. He informed the mayor that he was facing a small cog of a great organization that had done much in the last thirty-five years to conserve national resources. Briefly he outlined the educational methods employed. The day had come when the older engineers must show the results of the training the organization had given them and the younger members must take full advantage of the opportunities offered. The Government needed the best services of all.

For the first time in the history of the organization a national president had visited the state and was in attendance at the convention. The honor was appreciated and those present listened with interest to a brief address by John A. Wickert. In his opinion the engineer had the opportunity to be the man of the future. He was recognized more than ever before, as a man belonging to a profession. Those engineers who did not wake up to their responsibilities would find that other men would supplant them. Mention was made of the power-plant cost-data system that had been added to the educational program and of the help it would be in filling out intelligently the Government questionnaire. The president bespoke a big attendance at the national convention, where the educational features were to be the big thing and the entertainment secondary. Good delegates were requested—men who could bring back intelligent reports.

A patriotic address by James E. Bromwell, of Marion, was the event of the evening session. It was of exceptional quality and was commented upon highly by all present. "How many of you are true soldiers?" was the opening remark of National President Wickert. "Last year millions of tons of coal were wasted. Are you doing your share to conserve it?" The whole country is demanding service and none were better prepared than the engineer to give it. It was obligatory upon the engineer to attend meetings and better prepare himself for the work demanded. Subscriptions to the Red Cross and the buying of Liberty Bonds was not enough. Each engineer must recognize his responsibility and learn to do his work to the best possible advantage.

National Secretary Raven reminded the engineers that all of them were drafted. Each had his work, and his efforts had just as much to do with the results of the war as those of the men at the front. Dancing followed, with music by the Laas orchestra.

At the Thursday morning session J. H. Coates lectured on condensers. He outlined the theoretical possibilities of the condenser and told why maximum results could not be obtained in practice. The two general types, surface and jet, were discussed, the latter type including the low-level or ejector condenser and the high-level jet condenser of the barometric type. The construction, advantages and disadvantages and the auxiliaries required were given attention in each case, and some mention was made of the recent advances in cooling-tower construction.

J. M. Drabelle, of the Iowa Railway and Light Co., had an ascilograph at the hall. It was in running order and each engineer had an opportunity to see the wave line of the particular circuit to which it was attached. At the meeting its action was briefly explained and the speaker told how instantaneous information given by the instrument, and not available from the ordinary switchboard instruments, helped to locate troubles at the plant or in the line.

R. H. Holbrook, president of the local association, talked on fuel. In the United States about 1,900,000 tons of coal per day had been mined, while 2,300,000 tons would be required to carry on all industries satisfactorily. There would be a daily shortage of 400,000 tons of coal, or 120,000,000 tons per year of 300 days. He enjoined engineers to use their heads and to follow Government advice given in

MEMBERS AND THEIR GUESTS ATTENDING THE FIFTEENTH ANNUAL CONVENTION OF THE IOWA

regard to coal economy. Transportation difficulties and the zone system were reviewed and the Iowa situation discussed. In Iowa boys' help was counted upon to solve the labor problem at the mines. If handled right Iowa fuel would give excellent results. With the moisture and ash out it was better than Illinois coal and as good as the fuel formerly obtained from Kentucky. It was a question of learning how to use it, and in this connection the campaign of a year ago would be continued.

Thursday afternoon and evening were given over to the exhibitors. In the evening the feature was a smoker.

The last session of the convention on Friday morning was given over to committee reports and routine business. The license law committee was instructed to coöperate with other engineering bodies with a view to the enactment of license legislation. A motion calling for discontinuance of the state convention until the war is over, was lost. State Deputy Holbrook reported relatively large increases in several associations of the state and urged to greater effort the locals that had not shown a gain. National Secretary Raven reviewed the work of the national association up to date. Up to the present the finances were ahead of those of last year. He emphasized the necessity for careful selection of officers and delegates and in general pointed out the duties of all.

As the next convention city Marshalltown had no opposition. The following officers were elected: Robert Mullin, president; P. H. Heise, vice president; Abner Davis, secretary; J. A. Coulson, treasurer; R. Moore, conductor; S. C. Dike, doorkeeper; R. H. Holbrook, state deputy.

Firms having display space at the convention were: American Engineering Co., American Steam Conveyor Corporation, Anchor Packing Co., Baker Valve Co., Cedar Rapids Pump Co., Crandall Packing Co., Crane Co., Dearborn Chemical Co., The Fairbanks Co., Fisher Governor Co., Garlock Packing Co., Gustave Lidseen, Hawk-Eye Compound Co., Hays Instrument Co., Hills McCanna Co., International Correspondence Schools, Jenkins Bros., H. W. Johns-Manville Co., Lunkenheimer Co., Murray Iron Works Co., Reordway Co., Sinclair Refining Co., Standard Oil Co., Viscosity Oil Co., Wehlage Electrical Co., Western Boiler Compound Co.

War Industries Board Moves to Obtain Capital for Power Plants

The War Industries Board has sent to Congress the draft of a proposed bill to appropriate $200,000,000 to increase the power supply in overloaded industrial centers of the East. Cities along the Atlantic Seaboard in which munitions and materials for war are being manufactured would be the especial beneficiaries under the measure, which has been committed to the care for the present of Representative Kitchin, chairman of the House Ways and Means Committee, on the House side, and of Senator Martin of Virginia, chairman of the Appropriations Committee, on the Senate side. The measure, it is understood, was drafted by Frederic Darlington, chief of the Power Plant section of the War Industries Board, at the request of Bernard M. Baruch, chairman of the board, and it is said to have the backing of President Wilson.

The measure is frankly emergency legislation, made necessary by the apparent need of the industrial section of the East for more power with which to turn out munitions of war. It is stated in Washington that the power supply of the East is obviously overloaded, and that while different sections of the country are also raising the question of not having sufficient power with which to turn out the munitions and material needed by the Government, it is the intention of the War Industries Board to see that the East is supplied first, and then endeavor, perhaps by additional legislation and appropriations, to supply other sections of the country. Until recently, it is stated in Washington, power companies with insufficient equipment, and without sufficient funds to purchase equipment, had expected to be assisted in obtaining capital and equipment through the War Finance Corporation, but now that that body has ruled in a manner which makes it unlikely that power companies can be so supplied, the need for empowering legislation of a specific and emergency character becomes apparent as one of the necessities for winning the war. It is said in Washington also that some of the power companies have come to see that if money is borrowed now for additional equipment which might not be needed at the end of the war, they would be doing themselves more harm than good in so borrowing money and increasing plant facilities.

Plans for passing the legislation desired have not been worked out in Congress, and until the proposed emergency legislation is introduced the War Industries Board is not likely to be able to make plans for the distribution of the capital when obtained. It is said in Washington that much more than the $200,000,000 now proposed to be appropriated will be needed, inasmuch as in the Pittsburgh district alone, which supplies power for a radius of 100 miles, it is estimated that $40,000,000 or $50,000,000 for additional plant facilities might be needed. The War Industries Board is now making a census of the various power needs of the different localities in the country engaged in war work. It is expected by the Washington correspondent of *Power* that the proposed emergency legislation will be difficult of passage in Congress, although it is admitted on all sides in Government industrial circles engaged in obtaining war material that some such legislation is needed at once.

STATE ASSOCIATION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS AT CEDAR RAPIDS

Improving Plant Efficiency at Both Ends of the Steam Cycle

On June 17, at a joint meeting of the Western Society of Engineers and the Chicago sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, two important papers having a bearing on fuel conservation were presented. The attendance was large and the material presented was received with unusual interest. The first paper on "Advantages of High Pressure and Superheat as Affecting Steam Plant Efficiency," by Eskil Berg, of the General Electric Co., dealt with the improvements in economy to be obtained at the upper end of the steam cycle, while D. W. R. Morgan, of the Westinghouse Electric and Manufacturing Co., in his paper on "Condensers" showed how better results could still be obtained at the lower limits of the cycle. Both papers with the discussion will appear in later issues of *Power*. Briefly, Mr. Berg showed that a more efficient turbine was obtained by a combination of high pressure and superheat, the latter being necessary to obviate as much as possible the troubles arising from condensation in the turbine. In Europe steam temperatures of 700 deg. and higher are common. In this country boilers have been built for 350 lb. pressure and for a certain installation in England, B. & W. boilers were designed for a working pressure of 500 lb. With a superheat ranging from 200 to 300 deg., the final steam temperature would reach 800 deg. This would necessitate smaller tubes in the boilers, redesigning of the auxiliary equipment and elimination of joints by welding the piping system solid.

The salient features of the two general types of condenser, surface and jet, were brought out by Mr. Morgan. The three principal losses are drop in vacuum through the condenser, difference in temperature between the steam and condensate and incomplete air removal. The speaker pointed out where improvement is possible and compared the various auxiliaries in common use, such as circulating pumps and air pumps of the reciprocating, hydraulic and steam-ejector types. Owing to the shortage of copper the Government is seriously considering the elimination of the surface condenser for the period of the war. The effect on the coal pile must of course be considered, but the great saving in material by the use of jet or barometric condensers demands attention. With proper steps toward eliminating the action of the water, steel tubes might be used to advantage in surface condensers. In heat transfer the time element would be an important factor and would call for low circulating-water velocities.

There Should Be No Letup During the Summer Months*

With the advent of the hot weather a falling off in the sales of Thrift and War Stamps may be expected unless the efforts of the patriotic workers are not suffered to diminish. There need be no falling off in the sales, however, if we all keep our heads and continue to view the situation sanely and clearly. Let each one of us ask himself or herself whether the need for our coöperation is as great among the Allies as it was and then, when we have answered our own question in the affirmative (and who could answer it otherwise?), let us make up our minds at once that while the need exists the money shall be supplied. There were a million reasons advanced during the last Liberty Loan campaign why everyone should subscribe and induce others to do likewise, and there was not a reason advanced at that time that does not apply with just as much force to the War Savings Stamps now.

Someone may say, "But I've bought stamps until I'm almost broke," and they may really feel that they have a valid reason for not buying more, but people who talk like that have failed to grasp the significance of the situation. Such people do not stop to consider their sacrifices as compared to the sacrifices that are being made daily, hourly by the young men of America who are on the firing line in Europe.

There really should be no need to plead with anyone to buy stamps and thus have a part, though a small one, in this the greatest movement in the history of man. Every individual should consider this not alone a duty, but a great privilege. Now, viewing the matter from another angle, divesting the question of all sentiment, patriotism and obligation, let us consider it as a matter of dollars and cents.

And let us remember right at the start that we are not giving, we are receiving. We lend on the best security in the world and in five years the loan is returned with interest. But that is not all. Let us also remember that after peace has been restored and conditions return to normal the purchasing value of the dollar will be greater by far than it is now, so that every dollar saved now will doubtless do the work of two or more in a few years.

There is nothing new in the foregoing, but for the sake of emphasizing the importance of the War Savings Stamp campaign let us continue to keep this important matter before the people.

*From New York "Evening Sun."

National War Savings Day

Every loyal American is being called upon to sign a War Savings Stamp pledge card that is in effect a renewal of the promise of loyalty that arose, consciously or unconsciously, from the heart of every American when the news came from Washington a year ago that we had entered the conflict and ranged ourselves on the side of civilization against the forces of destruction. The pledge card also means that the signer takes up anew the fight against extravagance and waste, which are enemies as deadly to the cause of the Allies as any bullet that wings its way from the German lines.

Remember this: You take no chances when you go the limit on War Savings Stamps. They are the best and safest investment in the world. They pay you 4 per cent. interest, compounded quarterly. They can't go below par. You can get back every dollar you put into War Savings Stamps any time you need it. You can turn them in at the Post Office any time for their full value plus interest.

Uncle Sam is asking hundreds of thousands of men to give their lives to their country. He is asking you only to lend your money. What are you lending?

June 28 is National War Savings Day. That's the day we sign up, telling Uncle Sam just how much we can or will do to help win the war. You are expected to pledge the full amount that you can afford to use to buy War Savings Stamps during the remaining half of 1918.

In every state, county, city, town and village the War Savings committees have prepared for this big patriotic rally day. Unless you have already bought W. S. S. to the $1000 limit, get busy and figure out the utmost you can do.—*W. S. S. Committee.*

Establish United States Service Clearing House for Engineers

Placement of engineers as civilians in any and all Government departments as well as in private positions will be the function of the newly established service clearing house in Chicago of the United States Employment Service of the Department of Labor. For some time a division of education has been operating, and this week a division of engineering was initiated with the appointment of A. H. Krom as director, reporting to Dr. P. L. Prentis, district superintendent. Offices have been taken at 29 South La Salle St

After graduation as an electrical engineer from Purdue University in 1910, Mr. Krom was for three years with the Commonwealth Edison Co., one year chief engineer of the Haskins Glass Co., two years power engineer of the Central Illinois Public Service Co., two years with the Illinois Public Utility Commission, one year assistant engineer at Springfield and one year as engineer in charge of the Chicago office. For the last 18 months he has been secretary of the American Association of Engineers.

National Coal Association's Program To Increase Coal Output

The National Coal Association issued the following statement June 15:

The National Coal Association, composed of bituminous operators, whose annual output exceeds 350,000,000 tons, has undertaken a program of maximum effort to increase production and minimize the serious results of the threatened shortage in coal next winter which now appears to be almost inevitable.

The entire membership of the association, consisting of approximately two thousand coal-mine owners and operators, is undertaking by scientific management and in other ways to increase production to the greatest possible total. A coal-production committee, of which A. R. Hamilton, of Pittsburgh, is chairman, has been appointed by the Board of Directors with instructions to coöperate to the fullest extent with the Fuel Administration and to comb the industry for practical ideas and suggestions to increase the amount of coal mined during the coming summer and fall.

Every producing field in the country is represented on the committee. Meetings will be held in Washington, beginning at an early date and continuing practically without interruption. Problems confronting the industry will be studied carefully, and constructive steps looking toward greater efficiency will be put into effect wherever possible.

At its annual convention in Philadelphia last month, the association pledged to the Fuel Administration its wholehearted support and endeavor in producing a maximum output. The appointment of the coal-production committee and the great program confronting the committee are an earnest of the intention to fulfill that pledge.

Mine output has been restricted greatly in the past by the shortage of railroad cars at the mines. To this dominating factor in curtailing production have recently been added others, among them being difficulty in securing sufficient labor and mine supplies. The coal operators realize that the situation confronting the nation is a serious one, calling for the best thought of the industry; the problem of producing more than 12,000,000 tons of coal weekly—an output never reached before—is no little one; but nothing that can be done will be left undone to mine coal.

New Publications

FUEL ECONOMY IN THE OPERATION OF HAND FIRED POWER PLANTS

The scarcity of coal last winter and the recent warnings of the Fuel Administration regarding the possibility of a shortage next winter emphasize the need for greater economy in the use of fuel. The present high rate of production is still insufficient to supply all needs and there seems to be no possibility of an increase in the output of the mines sufficient to satisfy every demand. There are two possible results of this fuel shortage; either certain industries must close down or more work must be done with the coal available. The Engineering Experiment Station of the University of Illinois has issued a 90-page booklet printed in four colors which shows that the average small power plant can save 15 per cent. of its fuel by the exercise of greater care in equipment and operation. This means a saving of 12 or 13 million tons per annum if applied throughout the country. The purpose of the publication is to present to owners, managers superintendents, engineers and firemen certain suggestions which will help them in effecting greater fuel economy and in determining the properties and characteristics of the coal purchased. Features of installation essential to the proper combustion of fuel are discussed, the practice to be observed in the operation of the plant is outlined, and the employment of simple devices for indicating conditions of operation is prescribed.

Only a limited supply of copies of this publication is available for free distribution. Requests for copies should be directed to the Engineering Experiment Station, Urbana, Ill., and should specify "Circular No. 7."

Miscellaneous News

An Economizer and Boiler Exploded in the central power plant of the New Orleans (La.) Railway and Light Co. on June 10, injuring eight men, two probably fatally, and plunged the city into almost total darkness for nearly an hour. The business section of the city was kept lighted through sub-stations. The damage is estimated at $50,000. A fuller report of the accident will appear in a coming issue.

Feather River Development—The development of hydro-electric properties along the Feather River is the principal feature of the program of the California State Railroad Commission to increase the electric power production of the state. The plan suggested by the Railroad Commission includes the joint development by the Great Western Power Co. and the Pacific Gas & Electric Co. of the tremendous power possibilities along the Feather River. The work as proposed would mean the expenditure of at least $30,000,000. Government financing for the development is proposed.

Millions Saved by Daylight.—France, it is understood, estimates her saving in lighting and fuel alone by the daylight saving plan at not less than $10,000,000 a year. England is reported to have saved gas and electricity to the extent of about $12,000,000, and actually saved 300,000 tons of coal in the summer of 1916. Edinburgh saved $50,000 in fuel alone. Manchester, England, decreased lighting cost 15 per cent. over the previous year, and Nottingham 25 per cent. In Vienna the saving in lighting bills was $142,000. The estimated possible saving for the United States for the five months under this plan is placed at from $25,000,000 to $50,000,000 in lighting bills, and in fuel several million more.

Continued Failure of Coal Transportation—The failure of car supply at the coal mines still continues as is evidenced by conditions at the properties of the W. S. Barstow & Co. The normal supply should be at the rate of 266 cars per month and at no time during the past seven months has it been 50 per cent. The actual record is as follows:

	Cars
November	129
December	80
January	52
February	70
March	101
April	118
May	124

Unless there is a pronounced improvement in car supply in the next four months there is no doubt that the coal experience of last fall will be repeated during the coming winter, even though the winter may be a mild one.

Business Items

The Westinghouse Electric and Manufacturing Co., Pittsburgh, Penn., has purchased the property, business and good will of the Krantz Manufacturing Co., Inc., Brooklyn, N. Y., manufacturers of safety and semisafety electrical and other devices. The supply department of the Westinghouse Electric and Manufacturing Co. will act as exclusive sales agent for the products of the Krantz Manufacturing Co., whose business will be continued under its present name. H. G. Hoke, of the former company, will represent the supply department at the Krantz factory.

NEW CONSTRUCTION

PROPOSED WORK

R. I., Woonsocket—W. F. Fontaine, Arch., 285 Main St., is in the market for motors, etc., in connection with the erection of a 3 story spinning mill on Cass Ave.

N. Y., Hudson—B. Wenzel is considering plans for the erection of an electric lighting plant. Water from Lake Charlotte will be used to generate the power.

N. Y., Kings Park—The State Hospital Commission received bids June 12, for the installation of a heating system, etc., for the Employees' Home at the Kings Park State Hospital, from the W. B. Armstrong Heating Connections Co., 3 Fulton St., Albany, $20,966; Murtaugh & Reddington, 26 Pleasant St., Rochester, $22,500.

N. Y., New York—The Bureau of Yards & Docks, Navy Dept., Wash., D. C., plans to install boilers and superheaters at the Navy Yard, here. Estimated cost, $100,000.

N. Y., Olean—The Board of Armory Commission, 158 State St., Albany, received low bids for the installation of a heating system in its proposed 2 story, 52 x 110 ft. armory, from Hickey Bros., 256 North Union St., $4574; W. H. Simpson, 184 North Union St, $4853; Murtaugh & Reddington, 26 Pleasant St., Rochester, $7500. Noted June 4.

N. Y., Peekskill—The Village is in the market for new pumping apparatus. H. W. Taylor, 26 Cortland St., New York City, Consult. Engr.

N. J., Newark—The American Oil and Supply Co., Lafayette St., will soon receive bids for the installation of heating, lighting and plumbing systems in the proposed 1 and 2 story warehouse. P. B. Taylor, Essex Bldg., Engr.

N. J., Pompton Lakes—City will receive bids until July 2, for the erection of a brick and concrete power plant near the Pompton Lake Dam. Equipment including 2 turbine engines, electric switchboard, etc., will be installed. Estimated cost, $42,000. Noted June 4.

Penn., Hillsville—The Bessemer Limestone Co., Bessemer, plans to install an electric haulage system in its plant here. Estimated cost, $60,000.

Wash., D. C.—The Bureau of Accounts and Supplies, Navy Dept., Wash., D. C., will soon award the contract for machine and machine tools as follows:

(Item 1) two 15 hp. electric motors, 900 r.p.m.

(Item 2) one 15 hp. electric motor, 1200 r.p.m.; Class 397, Schedule No. 4704½.

Wash., D. C.—Bids will be opened June 25, by the Bureau of Supplies and Accounts, Navy Dept., for machines and machine tools:

(Item 1) 2 motor driven, double spindle, threading bolt machines; Class 423, Schedule No. 4733½, delivery Navy Yard, Norfolk.

(Item 1) 1 motor and drum type controller and pulley; Class 427, Schedule No. 4735½, delivery Navy Yard, Brooklyn.

June 28. (Item 1) 1 motor driven, cylinder grinding machines; Class 434, Schedule No. 4720½, delivery Navy Yard, Boston.

(Item 1) 10 turbo generating stes, 200 kva., 220 volt. a.c., 3 phase, 60 cycle; Class 432, Schedule No. 4738½, delivery Brooklyn, N. Y.

Va., Hampton—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to install boilers and superheaters at Navy Yard, here. Estimated cost, $90,000.

W. Va., Mabie—The Randolph Smokeless Coal Co., is having plans prepared for the erection of a new plant near here. Electrical equipment will be installed. Total cost, $100,000. A. F. Bennett, Philippi, Pres.

Ga., Flovilla—City plans an election soon to vote on $25,000 or $30,000 bonds for the erection of an electric lighting plant and a water works system.

La., Cheneyville—City plans an election soon to vote on $16,000 bonds for the construction of an electric lighting plant and a water works system.

Tenn., Nashville—Morgan & Hamilton, 1400 8th Ave., N., plans to install motor driven machinery in its new addition now being constructed.

Ky., Seargeant—The Whitley-Elkhorn Coal Co. plans to install electrical equipment in its plant here.

Ohio, Akron—Summit Co. received low bids for installing a heating system in the proposed 2 story dormitory addition to the Children's Home, from the Akron Plumbing and Heating Co., 73 West Exchange St., $3645; the Industrial Heating and Engineering Co., 413 Ohio Bldg., $3785; the H. P. Cahill Plumbing and Heating Co., 4 South Canal St., $3975.

Ill., Chicago—The Illinois Central R.R., 135 East 11th St., plans to install a low pressure steam heating system, direct radiation, in its proposed through depot on 53rd St. A. S. Baldwin, Ch. Engr.

Ill., Chicago—The Trustees of Sanitary District, 910 South Michigan Ave., received low bids (a) building a sewage pumping station, (b) furnishing 6 centrifugal pumps with auxiliary machinery, piping, etc., (c) one 72 in. centrifugal pump, complete, (d) 8 synchronous motors, exciters, etc., (e) switchboard, conduit and wiring, from T. J. Forschner Contg. Co., West Pullman. (a) $922,278, (b) $231,000, (c) $65,000, (e) $50,000; Nash Bros., 10 South La Salle St. (a) $1,547,000; Nash-Dowdle Co., 29 South La Salle St., (a) $1,396,653, (b) $230,000, (c) $16,000, (e) $47,500; Camden Iron Works, Linn and Coppers Creek, Camden, N. J. (b) $254,300, (c) $46,000; The Electric Machinery Co., 14th Ave. and Tyler St., Minneapolis, Minn. (d) $120,000; General Electric Co., 53 West Jackson Blvd. (d) $123,494; Westinghouse Electric and Manufacturing Co., Indiana Harbor, (d) $131,000; Beaver Electric Constr. Co., 30 North La Salle St., (e) $49,495.

Wis., West Milwaukee (Milwaukee)—The Globe Seamless Steel Co., Colby Abbott Bldg., is in the market for three 10 ton electric cranes in connection with its proposed 1 story factory. F. J. O'Brien, Gen. Mgr.

Kan., Baxter Springs—The Big Lead Mining Co. will build a concentration plant and install air compressor, engines, boilers, etc., in same. Estimated cost, $60,000. J. E. Hoshal, Supt.

Kan., Baxter Springs—The Cortez Mining Co., Jefferson City, Mo., will build a power plant, etc., near St. Louis, Okla. Equipment including a 125 hp. boiler, motors, pumps, etc., will be installed in same. Total cost, $68,000.

Kan., Newton—The City plans to build a sewage disposal plant and install two 300 gpm. motor driven centrifugal pumps, etc. in same. Black & Veatch, 502 Interstate Bldg., Kansas City, Mo., Engr.

Kan., Pittsburg—The Joplin and Pittsburg R. R., 1st National Bank Bldg., Kansas City, Mo., plans to build power houses and a 45 mi. transmission line from here to Columbus, Kan., and Miami, Okla., in connection with the construction of the new electric railway. Estimated cost, $400,000. E. E. Maxwell, Pittsburg, Ch. Engr.

N. D., New England—The Aaby Light and Power Co. plans to build an electric lighting plant and a flour mill.

Mont., Saco—D. T. Gilbert plans to extend and improve his electric lighting plant here.

Mo., Badger—The Badger Mining and Development Co. is in the market for belts, engines, boilers, etc., for installation in its proposed concentration mill near here. Total cost, $60,000. T. E. Forester, 103 Miners Bank Bldg., Joplin, Supt.

Mo., Joplin—The Connor Investment Co., Miners Bank Bldg., is in the market for boilers for the heating system in the proposed hotel annex on 4th and Joplin Sts.

Mo., Joplin—The Klein and Stern Investment Co., Frisco Bldg., will build a concentration plant. New equipment including engines, boilers, etc., will be installed in same. Estimated cost, $35,000. A. Klein, Supt.

Mo., Joplin—The Miami Yellville Mining Co., West 7th St., will remodel its concentration plant and re-equip same Mashinery to be installed includes engines, boilers, etc. Total cost, $25,000. J. Taylor, Main St., Supt.

Mo., Joplin—The Muskogee Lead and Zinc Co. is in the market for conveyors, air compressors, etc., to installation in the proposed concentration mill near here. Total cost, $58,000. E. C. Beatty, Springfield, Supt.

Mo., Joplin—The Playter Bros. Mining and Realty Co., 315 Wall St., will build a concentration plant at the Silver Fox Mine near Monarch, Kan. Boilers, engines, belts, etc., will be installed in same. Total cost, $60,000. G. H. Playter, Mgr.

Mo., Richmond—The Missouri Gas and Electric Service Co. plans to enlarge or improve its plant here. J. H. Boggs, Engr.

Okla., Pilcher—The Southwest Missouri R.R., Webb City, plans to build an 18 mi. transmission line from here to Miami, in connection with the construction of a new electric railway. Estimated cost, $150,000. A. H. Rogers, Webb City, Pres.

Okla., Poteay—The Citizens Consolidated Power and Electric Co., recently incorporated, has petitioned the city for a franchise to install and operate an electric lighting plant.

Okla., Quapaw—The Miami Co. will build a concentration plant near here. Equipment including boilers, air compressors, etc., will be installed in same. Total cost, $250,000. J. P. McNaughton, 8 A St., S. E., Miami, Supt.

Colo., Brighton—The Town is in the market for new pumping machinery in connection with its proposed water work extensions. Total cost, $50,000. P. O'Brien, 306 American Bank and Trust Co., Denver, Engr.

Colo., Sterling—The Presbyterian Congregation will soon award the contract for the installation of a steam heating system in its proposed church. Wilson & Wilson, Commonwealth Bldg., Denver, Arch.

Wash., La Crosse—The Washington Water Power Co., Spokane, may take over the electric lighting plant here, and extend an electric transmission line from here to Endicott. C. E. Uhden, Spokane, Ch. Engr.

Cal., Tiburan—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., plans to build a power house and a machine shop here. Estimated cost, $8000.

CONTRACTS AWARDED

Mass., Boston—The Board of Education has awarded the contract for the installation of a direct radiation system in the English and Latin High Schools on Warren Ave., to the J. L. Hern Engineering Co., 68 East St., $20,500. Noted May 28.

N. Y., Brooklyn—The Doehler Die Casting Co., 9th and Huntington St., has awarded the contract for the erection of a 7-story factory. A steam heating system and boilers for same, will be installed.

N. J., Kearney—(Arlington P. O.)—The Ford Motor Car Co., Highland Park, Detroit, Mich., has awarded the contract for the electrical work in connection with the proposed factory here, to the K. W. Electric Co., 49 Lawrence St.

Ky., Fulton—The Illinois Central R. R. 135 East 11th St., Chicago, has awarded the contract for the erection of various units including a 40 x 50 ft. boiler house here, to J. E. Nelson & Son, 118 North La Salle St., Chicago. Total cost, $225,000. The company is in the market for two 150 hp. boilers. Noted June 11.

Ohio, Columbus—G. Borden, Director of Public Service, has awarded the contract for the installation of a new heating system in the city hall, to the Huffman-Wolfe Co., Columbus. Estimated cost, $15,233. Noted May 14.

Ill., Amboy—The Illinois Central R. R., 135 East 11th St., Chicago, has awarded the contract for the erection of various units including a 40 x 150 ft. machine shop and boiler room, an 100 ft. electric turntable, etc., here, to W. J. Zitterell, Webster City, Ia. Total cost, $250,000. The company is in the market for two 150 hp. boilers. Noted June 11.

Ill., Carbondale—The Illinois Central R. R., 135 East 11th St., Chicago, has awarded the contract for the erection of various units including a 40 x 150 ft. boiler room and machine shop, an 85 ft. electric turntable, etc. here, to the Leyden & Ortseifen Co. 53 West Jackson St., Chicago. Total cost, $250,000. The company is in the market for two 150 hp. boilers. Noted June 11.

Ill., Mounds—The Illinois Central Ry., 135 East 11th St., has awarded the contract for the erection of a 40 x 50 ft. boiler house, an electric table, etc., in connection with the proposed improvement of terminal facilities here, to G. B. Swift & Co., 189 West Madison St., Chicago. Total cost, $250,000. The company is in the market for two 150 hp. boilers. Noted June 11.

Kan., Baxter Springs—The Board of Education has awarded the contract for the installation of fans and ventilation system in the Mark Twain and Eugene Field schools, to the M. C. Woodlong Heating and Ventilating Co., 512 Reliance Bldg., Kansas City, Mo. Estimated cost, $10,168. Plans include the installation of electric motors, fans, belts, wiring, electric switches and switchboards.

Mo., Kansas City—The Kansas City Railways, 303 Montgall St., has awarded the contract for the erection of a 43 x 82 ft. substation, to the L. Breitag and Son Constr. Co., 3701 West Prospect Pl. Estimated cost, $25,000. Noted May 14.

THE COAL MARKET

Boston—Current quotations per gross ton delivered alongside Boston points as compared with a year ago are as follows:

ANTHRACITE

	Circular Current	Individual Current
Buckwheat	$4.60	$7.10—7.35
Rice	4.10	6.65—6.90
Boiler	3.90	....
Barley	3.60	6.15—6.40

BITUMINOUS

Bituminous not on market.

Pocohontas and New River, f.o.b. Hampton Roads, is $4, as compared with $2.85—2.00 a year ago.

*All-rail to Boston is $2.60. †Water coal.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* are as follows:

ANTHRACITE

	Circular Current	Individual Current
Pea	$4.90	$5.65
Buckwheat	4.85	5.60
Barley	3.80	4.00
Rice	4.25	4.80
Boiler	....	....

Quotations at the upper ports are about 5c. higher.

BITUMINOUS

	F.o.b. N. Y. Gross	Mine Price Net	Gross
Central Pennsylvania	$5.06	$3.05	$3.41
Maryland—			
Mine-run	4.84	2.85	3.19
Prepared	5.06	5.05	3.41
Screenings	4.50	2.55	2.85

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater, or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The ratte to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Current	One Yr. Ago	Current	One Yr. Ago
Pea	$3.45	$3.10	$4.70	$4.00
Barley	2.40	1.90	3.30	2.15
Buckwheat	3.40	2.90	4.40	3.80
Rice	2.90	2.40	3.80	3.40
Boiler	2.70	2.20	3.70	3.30

Chicago—Steam coal prices f.o.b. mines:

Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes	$2.55—2.70	$3.25—3.40
Mine-run	2.35—2.50	3.00—3.15
Screenings	2.05—2.20	2.75—2.90

St. Louis—Prices per net ton f.o.b. mines are as follows:

	Williamson and Franklin Counties	Mt. Olive & Staunton	Standard
6-in. lump	$2.55-2.90	$2.55-2.70	$2.55-2.70
2-in. lump	2.55-2.90	2.55-2.70	2.55-2.70
Steam egg	....	....	2.20-2.40
Mine-run	....	2.35-2.50	2.00-2.20
No. 1 nut	2.55-2.90	2.55-2.70	....
2-in. screen	2.05-2.20	2.05-2.20	....
No. 5 washed	2.05-2.20	2.05-2.20	....

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Lump & Nut	Slack and Screenings
Big Seam	$2.05	$2.35	$1.75
Pratt, Jagger	2.25	2.55	1.95
Corona	2.30	2.65	1.95
Black Creek, Cahaba	2.75	3.00	2.35

Government figures.

Individual prices are the company circulars at which coal is sold to regular customers irrespective of market conditions. Circular prices are generally the same at the same periods of the year and are fixed according to a regular schedule.